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JULY 1996

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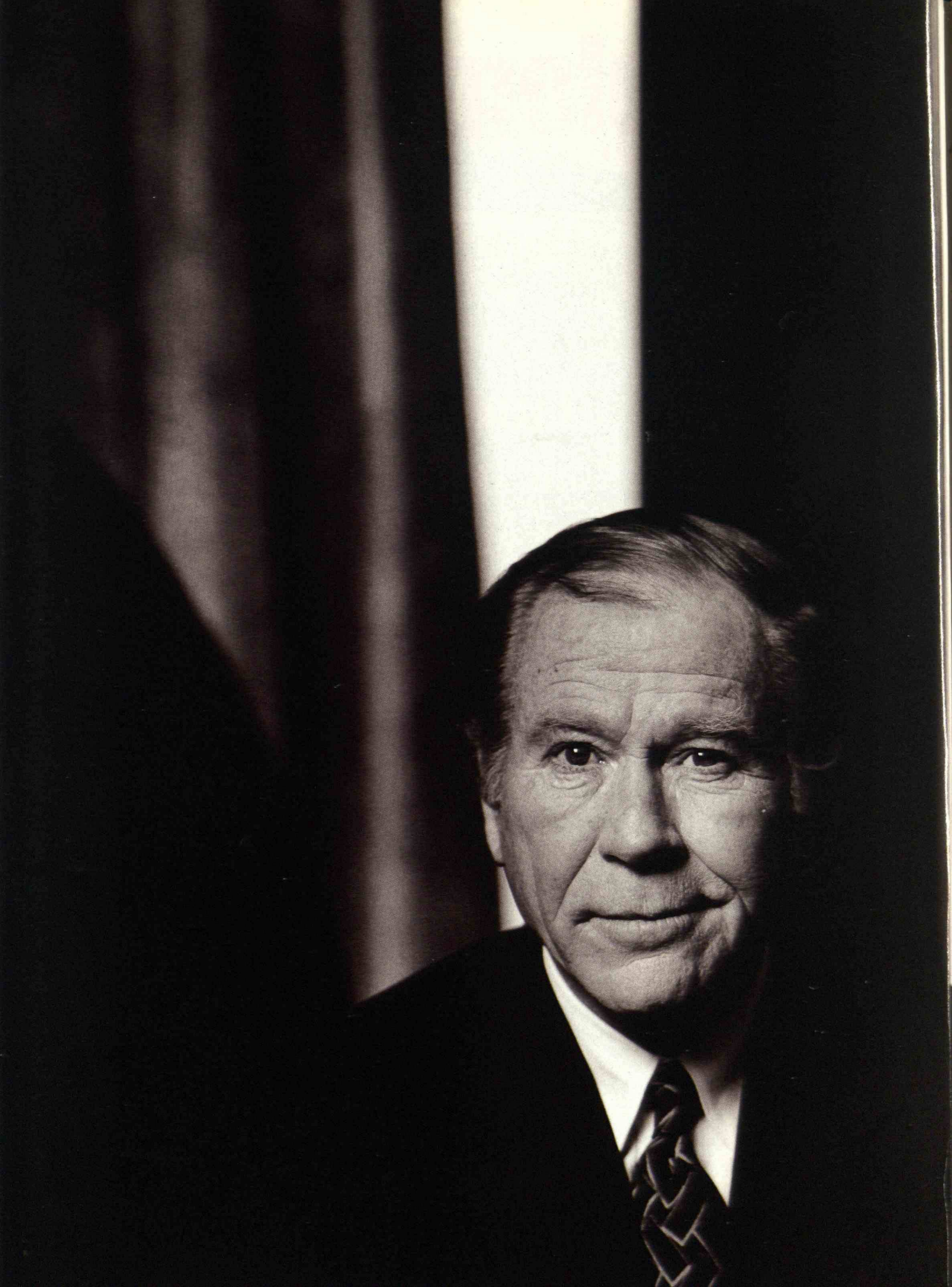
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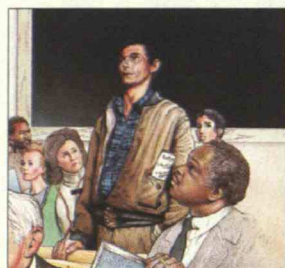
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Contents

FEATURES



24

24 TOWN MEETINGS ON TECHNOLOGY

BY RICHARD E. SCLOVE

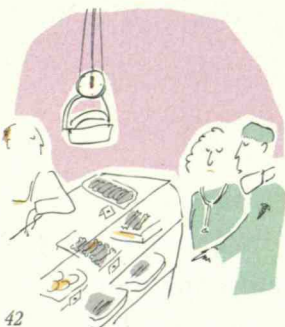
Pioneered in Europe, a forum that allows laypeople to render nonbinding judgments on complex technical matters has provoked spirited public discussion and helped government and industry decide which policies and products to pursue. The United States might do well to adopt its own version of this innovative process.



32

32 THE WEB MAESTRO: AN INTERVIEW WITH TIM BERNERS-LEE

The man who invented the World Wide Web and remains its architect-in-chief talks about why and how he evolved the mother of all systems for "hyperlinking" information on millions of computers. While he challenges the notion that all such information should be instantly accessible and strictly kosher, he nevertheless describes scenarios for making the Web even more accessible, interactive, and useful.



42

42 PORK LIVER, ANYONE?

BY STEVEN ALAN EDWARDS

Once viewed as exotic and inherently risky, the fledgling field of xenotransplantation—the use of animal organs and tissues in human beings—is gaining credibility. While experimental baboon operations have received much of the press, several small biotech companies, backed by large corporate sponsors, are investing heavily in the safer and more practical prospect of transplanting spare parts from pigs.



50

50 THE TWILIGHT OF SCIENCE

BY JOHN HORGAN

Standing on the shoulders of giants, modern researchers face a shrinking scientific horizon. Their lot may be either to continue applying and refining the great ideas of the past or to plunge into ever more speculative and untestable realms. Either way, says the author, pure science as we know it appears to be nearing an end.

DEPARTMENTS

5 FIRST LINE

A New Publisher Takes the Field

6 LETTERS

11 MIT REPORTER

New Medical Images with Laser Light; When Bad Things Happen to Good Factories

16 TRENDS

Plants: A Secret Weapon Against Global Warming; A Microgram of Prevention; Driving Simulators for the Elderly; Dvorak Keyboards: The Typist's Long-Lost Friend

62 FORUM

DAVID ORENTLICHER

As courts and legislatures in the United States establish the right to doctor-assisted suicide, stringent safeguards are essential to prevent the practice's abuse.

65 THE HUMANE ENGINEER

SAMUEL C. FLORMAN

Schools need teachers well versed in solving real-world problems. Graduating engineers need jobs. Is this the beginning of a beautiful friendship?

68 THE ECONOMIC PERSPECTIVE

BENNETT HARRISON

Multinational manufacturers and small-scale industries, supported by community/labor collaboration and targeted public policy, can revitalize blighted urban areas.

69 REVIEWS

Clark C. Abt on *Confronting the New Nuclear Threat* by Graham T. Allison et al.
Martin Cherniack on *Chernobyl: The Forbidden Truth* by Alla Yaroshinskaya.

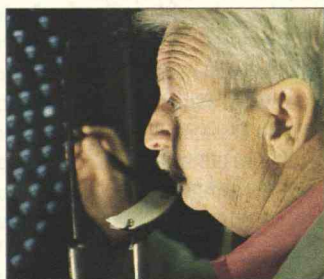
74 PHENOMENA

Anagrams Made Easy

75 TECHNOLOGY REVIEW CAREERS



11



16



69

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Paul Patt in the Chapel Listening Room.

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A NEW PUBLISHER TAKES THE FIELD

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Editor Publisher
Steven J. Marcus R. Bruce Journey

A baseball team boasting star players but lacking a manager won't likely have a winning record. An orchestra loaded with skilled performers but without a conductor rarely produces season after season of memorable concerts. For long-term success, organizations need leaders to help harmonize players' skills and provide focus, direction, and strategy, not just in pursuit of the group's particular art form but on practical matters—those nitty-gritty economic realities that determine its very existence.

Technology Review is an organization blessed with star players and skilled performers in all departments: editorial, design, and business. And we have long had most, but not all, of the necessary complement for leading this talented staff. An editor-in-chief, managing editor, and design director have endeavored to ensure the quality of the product in both words and pictures. But a magazine is ultimately a business enterprise; it stands or falls on the strength of its circulation, advertising, and budgetary performance. And the fact is that *Technology Review* has never had a full-time professional business leader, otherwise known as a publisher, until now.

Throughout most of the magazine's 97 years, the title of publisher of *Technology Review* was delegated to the executive vice-president of the MIT Association of Alumni and Alumnae. But regardless of that person's enthusiasm, intelligence, sophistication, and commitment to the magazine—our incumbent, William J. Hecht, has personified all that and more during the past 16 years—he or she was in charge of a large and complicated operation (of which *TR* is but one small part), fulfilled other duties as a high-level university administrator, and did not usually hail from the publishing business to begin with.

We needed a publisher who had long played in the magazine big leagues, was familiar with all aspects of the business side of general-audience (as opposed to specialized trade or professional) magazines, and who had or could readily establish strong contacts with major national advertisers appropriate to *Technology Review*. He or she also had to be imaginative, persistent, and entrepreneurial in order to make the most of academia's scarce resources—and help create some.

We have found that person: I am pleased

to introduce R. Bruce Journey, our new publisher and chief executive officer, who comes to us from Time, Inc. Journey has served at *Time* and *Fortune* magazines for 11 years, the last 6 as advertising director of *Fortune's* New England office. He has also been the publisher or advertising director of several television and cinema magazines. We were pleased to have attracted an impressive field of candidates, but Journey was the clear choice.

"We are fortunate to have Bruce Journey joining our team," says Robert M. Metcalfe, member of the *TR* board and head of the publisher/ceo search committee. "*Technology Review* is ready to take its next big step, which will involve a lot of what outside MIT they call marketing. And Bruce knows how to market magazines. What's even better, *TR's* editors like him, which is very unusual for anybody who's ever sold advertising."

"Like him" is an understatement. Consider some of my colleagues' thumbs-up assessments: "Confident, straight shooter, energetic, savvy. A salesman-type, to be sure, but decidedly non-oily." "Intelligent and sophisticated." "Solid, down-to-earth,

and personable. I'd buy an ad from him." "Damn, he got me fired up about our future! I'm excited about where this guy wants to take *TR*. Let's go!" "Now Bruce Journey, *there's* a publisher. His excitement about the magazine seemed genuine, and I was encouraged by his vision. Despite a firm grounding in ad sales, he immediately saw potential for other, more forward-looking ways [such as an enhanced online presence, conferences, and various spinoffs] of boosting revenue."

For his part, Journey is as enthusiastic as we are and is looking forward to a rewarding partnership between business and editorial. "*Technology Review* has quality and authority," he says. "Its connection with MIT gives it great credibility, and there is no better time to have 'technology' in the title than right now" because it has become a major interest of an increasingly technology-literate general public. In keeping with these strengths, a magazine like *TR* should be much more of "a forum for people who influence the decision-making process." Where they don't yet know about *TR*, "my job is to tell 'em."

Technology Review is the only general-interest national-circulation magazine owned by a university. And as far as Journey is concerned, that particular university is uniquely matched to *TR's* business potential. "MIT understands commercial achievement and is not afraid of it," he says. "People here seem to want to make *TR* much more prominent and financially successful. My presence, to provide the drive to get there, is a testament to MIT's commitment."

Actually, all these good vibrations are starting to make me a little nervous: in the ethnic milieu where I grew up you wouldn't broadcast celebratory news too vigorously lest you give it a *kinehora*—a jinx on the whole affair. But why worry about the supernatural? All we mortals can do is make logical decisions—in this case, put in place the person with the best qualifications, most enthusiasm, and greatest likelihood of doing the job well. We've in fact picked a manager who knows major-league ball. And although he's a nice guy, he's not one to finish last. So I have a feeling, knock on wood, that *TR's* prospects for a championship are about to improve. ■

—STEVEN J. MARCUS

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STEVEN J. MARCUS

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COLUMNISTS

SAMUEL C. FLORMAN, BENNETT HARRISON,
ROBERT M. WHITE, LANGDON WINNER

CONTRIBUTING WRITERS

DEBRA CASH, DAVID GRAHAM, SETH SHULMAN,
P.J. SKERRETT, JANE STEVENS,
DAVID TENENBAUM, PETER TYSON

CHAIRMAN

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Letters

SCHOOL DAZE

With 20 years' experience teaching high-school chemistry and physics, I agree with Leon M. Lederman's premise in "Getting High School Science in Order" (*TR* April 1996) that the fight for science literacy "is a war well worth fighting, and it is winnable." But to win the war, we must start the battle long before students enter high school.

In the *New York Times* on January 7, 1990, Robert F. Watson, the National Science Foundation's director of undergraduate education, said "little children toddle off to school with positive attitudes toward science and math. By third grade, a tremendous number don't like it anymore. Unless you assume some physiological change is taking place, something is obviously happening in the schools." A majority of elementary-school teachers have almost no formal education in science. They admit science is their weakest subject, and their curriculum merely requires students to read some material and then complete worksheets. This is not science. Asking questions and then experimenting through hands-on activities to find answers is science. By changing science education at the elementary level, we can meet the prerequisites for successfully reorganizing the high-school science curriculum.

AVI ORNSTEIN
Educational Director
Little Scientists
New Britain, Conn.

Lederman's eloquent comments deploring our national scientific illiteracy are right on. What's more, I and many others I know, including some high-school educators, share his views on the poor sequencing of secondary science. However, many of us concerned about scientific illiteracy are less worried about

improving factual knowledge than about developing the ability to participate in the scientific process: to gather evidence, judge its validity, and carefully think through its implications. Unfamiliarity with this process underlies much of the irrational and often destructive decision making in our society.

The least likely place to instill inquiry-based science is in the high school. If we are concerned about eradicating scientific illiteracy in the shortest time, evidence favors K-6 reform, where the natural inquiry skills of children can be cultivated and scientific thinking can become a habit. Elementary teachers are also far more receptive to adopting inquiry pedagogy than high-school specialists for whom memorizing facts, using algorithms to solve problems, and achieving high AP test scores are too often the goals.

JERRY PINE
Co-Director, Precollege Science Initiative
Professor of Biophysics
California Institute of Technology
Pasadena, Calif.

Five years ago our school successfully instituted the science sequence Lederman recommends. With a physics background, our students are better prepared to understand, rather than just memorize, concepts in chemistry. The chemistry background in turn gives students a better understanding of biology. The later courses also reinforce earlier ones. When students reach their senior year, they can go on to a more traditional mathematics-based physics course or an advanced-placement science course.

RAZEL A. KALLBERG
Chair, Science Department
Berwick Academy
South Berwick, Maine

Continued on page 8

We welcome letters to the editor.

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Letters may be edited for clarity and length.

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LETTERS

Having taught high-school chemistry and physics for nearly 30 years, I observe that science without mathematics is like a building without a foundation. And the only mathematical skill that science requires is simple algebra. Open just about any high-school physics textbook and you will see nothing but algebra. No calculus, no wave equations, no differentials. And yet I have found that most of my tenth graders cannot solve simple algebraic equations.

The problem lies not in the order in which science is taught—kids somehow survive the biology-chemistry-physics sequence—but in the mathematical skills they bring to the sciences. And the problem is not in the high schools but in the middle and lower schools, where mathematics is not perceived as the means for solving real-world problems and is

therefore not appreciated as an indispensable tool for learning science.

We need a math/science curriculum that starts in kindergarten and runs through the twelfth grade. We need kids who can calculate simple math without their eyes becoming glazed, who can graph and correlate data, who can perform elementary experiments with basic instruments like stop-watches and meter sticks, and who can write a simple lab report.

Whether kids become scientists may well depend on their individual experiences, but all will become citizens in a technological world. Even science-ignorant school administrators are beginning to recognize that science is no longer a back-burner subject.

JOHN ROSS
Morrisville, Pa.

The recommendation by American Renaissance in Science Education (ARISE) that physics be taught to ninth graders on a conceptual basis, "deemphasizing mathematics," may have merit, but did Leon Lederman and members of ARISE ask any high-school science teachers about implementing such an idea?

For many years, I have taught physics on a conceptual basis using *Conceptual Physics* by Paul G. Hewitt. Such a book is the intellectual equivalent of eating meringue: there is some taste, but not very much substance. I have found it necessary to augment the book with handouts providing the mathematics that the author conceals from the students.

A conceptual physics book would have to be very carefully written to prove acceptable. One such book did exist, but it is now out of print. This was *Project Physics*, developed with grants from the U.S. Office of Education and the National Science Foundation and last revised in 1981. This superb text

effectively blended physics, math, and history. I wrote to the NSF several years ago suggesting that it support a new edition but never received a reply.

In any case, I shudder to think of having to teach physics to freshmen rather than seniors. Ninth graders have not yet developed disciplined study habits, require considerable socializing simply to adapt to the high-school environment, and thus are ill-prepared to take physics as their first science course. For purely selfish reasons, I would prefer that my colleagues continue to teach biology to ninth graders!

WILLIAM L.R. RICE
Science Department
Annandale High School
Annandale, Va.

We fully support Lederman's argument that an important step along the path to improved science literacy is reversing the traditional high-school science sequence of biology, chemistry, and physics. However, he has left out a significant element: the earth sciences, the study of the materials and processes of our planet, need to be added to the traditional triad of high-school science subjects. Indeed, the new national science education standards released by the National Academy of Sciences explicitly define content standards for earth and space sciences, as do the American Academy of Arts and Sciences' Benchmarks for Science Literacy.

These efforts are important because the earth sciences are inherently interdisciplinary and serve as effective vehicles for integrating scientific fields in ways that are immediately relevant to students. The earth sciences are basic to understanding the landscape and weather where one lives. And the global environmental problems Lederman mentions as in need of public understanding—the ozone layer, climate change, and biodiversity—are all manifestations of a dynamic planet (with an overlay of human intervention) and integrate physical, chemical, and biological processes.

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ROTE MEMORY NOT NEEDED

In "Long Live Roy G. Biv" (*Phenomena*, *TR* January 1996), senior editor David Brittan does us all a disservice by remembering the "good old days" when the art of memory was revered. Well, bah and humbug. The good old days were filled with dreary, worthless recitation of meaningless items to be learned—pointless exercises in futility.



In bemoaning the decision to allow students to use calculators during SAT exams, Brittan says this "proclaims that the ability to manipulate figures, either purely in one's head or with the aid of a pencil, will not be rewarded on Judgment Day." He says with horror, I say hurrah! Many technological advances serve as cognitive artifacts—tools of the mind—that allow us to surpass our limitations. The human species has survived because the mind has evolved to explore new horizons. It did not evolve to do arithmetic.

An artificial human invention, rote memory is simply never needed in nature. All the time wasted on an effort that

destroys our children's curiosity and eagerness to learn can be much better spent. When I took a course in rockets and satellites, the class struggled for weeks to perform computations using paper and pencil, slide rule, and the ancient mechanical calculators. Had advanced tools been available then, we could have explored a wider range of phenomena and come to a better understanding of the field.

DONALD A. NORMAN

Vice-President, Advanced Technology

Apple Computer

Cupertino, Calif.

TECHNOBUSINESS

The trend that Stephen Solomon covered in "An Engineer Goes to Wall Street" (*TR* January 1996) was presaged in the mid-eighties when Goldman Sachs replaced Du Pont and Exxon as the leading recruiter of MIT chemical engineers. Like the computer scientists cited by Solomon, these engineers are recognized for their analytical skills. But the glass ceiling Solomon reports is also in evidence, and creates a dilemma for curriculum design as well as for students. How much fundamental science and technology must be sacrificed in enlarging the curriculum to include culture and context? MIT is creating a number of integrated engineering-management programs to address this problem and overcome the weaknesses of both traditional MBA and advanced technical programs.

Stronger institutional partnerships between financial firms and higher education are also needed. Manufacturing industries have maintained a virtuous tradition of support for universities—partly from philanthropic motives, and partly in recognition of the symbiotic relationship. After all, universities provide the human capital that allows industry to thrive. In shouldering their share of the costs of research and education, employers draw closer to the faculty and the students whom they aim to hire, and obtain the additional benefits of exposure to the intellectual climate of the university.

Continued on page 64

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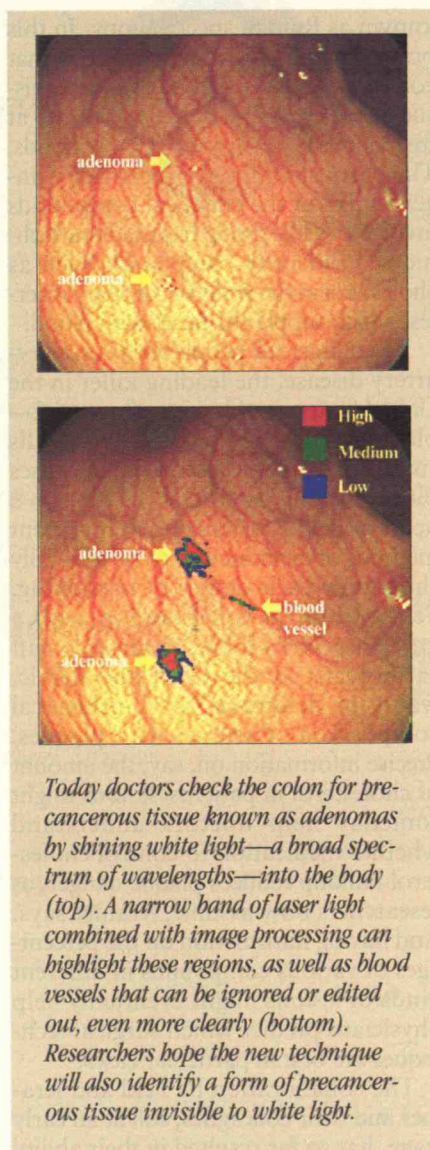
NEW MEDICAL IMAGES WITH LASER LIGHT

 Despite today's armamentarium of tools for peering inside living human beings, doctors still cannot see all that they would wish. For instance, current technology cannot detect flat sections of precancerous colon tissue—a serious concern, since colon cancer kills more people in the United States than any other form of the disease save that of the lungs. Nor can doctors confirm the brain plaques that characterize Alzheimer's disease until after death, during an autopsy.

Since the early 1980s Michael S. Feld, director of the George R. Harrison Spectroscopy Laboratory and professor of physics at MIT, and his colleagues have been developing a group of laser technologies that might let doctors image such abnormalities. His lab is in the "forefront" of this field, known as medical laser spectroscopy, says Richard Straight, director of the Utah Center for Photomedicine at the Salt Lake City Veterans Administration Medical Center.

One of the technologies furthest along in the Feld lab relies on laser light to analyze precancerous growths in the colon. Each year, doctors diagnose 124,000 people with colon cancer, and 55,000 die of it. Since early detection is key to preventing death, the American Cancer Society and the American College of Physicians recommend that everyone who is 50 and older obtain an exam of the lower part of the colon every three to five years.

Doctors perform this test by inserting into the colon a long, flexible instrument known as an endoscope, about the width of a finger. They then shine white light—the spectrum of wavelengths we usually think of simply as light—through optical fibers that run inside the scope and search for areas that might have atypical cellular growth. But unfortunately this approach doesn't detect precancerous lesions that are flat rather than raised. Hence even people who undergo regular rectal examinations can end up with colon cancer that



Today doctors check the colon for precancerous tissue known as adenomas by shining white light—a broad spectrum of wavelengths—into the body (top). A narrow band of laser light combined with image processing can highlight these regions, as well as blood vessels that can be ignored or edited out, even more clearly (bottom). Researchers hope the new technique will also identify a form of precancerous tissue invisible to white light.

goes unnoticed until it's too late.

Working with Feld, Thomas D. Wang, a Harvard Medical School student who this spring completed a PhD in the Harvard-MIT Division of Health Sciences and Technology, and other researchers have outfitted an endoscope so it can also train a laser beam of weak ultraviolet light on body tissue. Some of the light's photons cause molecules in the tissue to become momentarily excited, after which they produce lower-energy photons with fluorescent wavelengths that return to the light source.

Just which wavelengths bounce back depends on the tissue's "architecture," amount of blood flow, and cellular chemical makeup—factors that allow doctors to differentiate between precancerous and normal tissue.

Based on earlier studies by researchers at the Harrison Spectroscopy Lab and the Cleveland Clinic Foundation, Wang first set up an endoscope to deliver ultraviolet light that results in normal tissue returning fluorescence that's brighter than that sent back by precancerous tissue. He then developed image-processing methods that make the weaker fluorescence stand out as different colors on an attached, external computer screen.

In tests on colon tissue removed from patients, the researchers have found that the technique, called fluorescent spectroscopy, can identify flat as well as most raised regions of precancerous tissue. Investigators have also found that the procedure, which takes one-thirtieth of a second for each section of colon, can notice lesions in colons during patient exams. So far, follow-up pathology studies of all the lesions observed by the laser method have shown that they are indeed precancerous.

Since the researchers have not yet found flat lesions in the few dozen people examined to date—such diseased areas are uncommon—part of the continuing research will entail searching for such tissue in a larger patient group. Wang points out that studying more people is also important for developing a statistical sense of the value of adding the technology to white-light endoscope exams.

A laser-equipped endoscope for colon exams might reach the market in several years, Feld predicts. He also notes that a fluorescent-spectroscopy approach might work for observing mucosal tissue of other types, including the mouth, esophagus, lungs, bladder, and cervix—some of which are being examined by both researchers at the laboratory and investigators collaborating with it.

Researchers working with Feld have also been exploring medical applications of a form of laser-based tissue diagnosis

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known as Raman spectroscopy. In this process, a few of the many photons that come from a laser source and strike tissue cause chemical bonds to vibrate at frequencies characteristic of those bonds. The particular vibrations provide "fingerprints" of the chemical compounds involved. Feld's group has used this technique to identify compounds such as cholesterol in the walls of coronary arteries, which supply the heart with blood.

The danger for people with coronary-artery disease, the leading killer in the United States, is of lesions of material—plaques—attached to the artery walls rupturing at some point. That causes blood rushing by to clot, leading to a heart attack. Recognizing that current methods of examining arteries generally show only their degree of narrowing, Feld's team, in collaboration with a group headed by John R. Kramer, a staff cardiologist at the Cleveland Clinic, wants to determine the biochemical composition of arteries with plaques. Precise information on, say, the amount of cholesterol in patients' lesions might someday help doctors understand whether medication to control cholesterol buildup reduces plaque danger, as researchers now assume, Kramer says. And having information on the percentages of various compounds in different kinds of lesions might eventually help physicians predict which surgical techniques are best in particular cases.

The collaboration by Feld and Kramer and their colleagues, still at an early stage, has so far resulted in their ability to use Raman spectroscopy to identify three basic kinds of compounds in intact arteries, including cholesterol. The researchers are now refining the technology to increase the signal size compared with the background noise, to allow for the identification of more compounds and measurement of their concentrations. Later, they hope to develop biochemical profiles of the arteries of various kinds of patients, whom they will then follow to see what happens naturally to these people over time.

Researchers allied with Feld have also been trying to determine whether a

Raman-spectroscopy approach could identify glucose levels in tissue using laser beams of wavelengths that can penetrate several millimeters below the skin. Such a technology might eventually provide diabetics with a noninvasive way to check their condition; today these people usually prick their fingers several times daily to check their blood-sugar levels.

So far, tests of the technique on vials of blood have shown that the laser-based equipment needs refining to effectively capture photons returning from glucose molecules, says Irving Itzkan, a senior scientist at the center. The group is designing technology that will use a sophisticated mirror like the kind used in telescopes to collect the photons.

Peering Deep into the Body

Still other Harrison Spectroscopy Lab investigators are testing a third laser-based diagnostic approach that they hope could someday identify tumors deep in body parts not accessible by catheters or through external openings. Consider breast cancers, which typically require removing a chunk of tissue for positive identification, and brain tumors, which are identified today by relatively expensive techniques.

The researchers faced the problem that biological tissue is turbid and continuous beams of light sent through it scatter significantly. The group hit upon using short pulses of light, which don't scatter much. And to increase the contrast between normal tissue and a tumor, the investigators thought of relying on fluorescence. (Tumors can fluoresce because of their natural characteristics or with the aid of drugs that fluoresce and are attracted to such rapidly growing tissue.) In an early attempt to mimic a breast tumor, team members embedded a glass bead—the size of a BB pellet—that contained fluorescent material in a beaker stuffed with chicken-breast tissue. The investigators sent a short pulse of laser light into the top of the beaker, then noted the times needed for the fluorescence to be picked up by each of eight fibers encircling the beaker. Since that

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timing depends on the distance between the fiber and the embedded object, it provides information about the bead's location. By analyzing the timing data from each fiber, the researchers were able to localize the bead's position in the 64-millimeter-diameter beaker to a region less than 1-millimeter long. The result is promising enough, says Feld, that "we are now studying the issues related to trying the technique in patients."

Finally, this spring affiliated researchers began examining the use of both fluorescent and Raman spectroscopy on autopsied tissue from the brains of people with Alzheimer's disease. The team is trying to determine whether tissue that characterizes the condition, known as amyloid plaques, can return a photon signal significantly different from the photons sent back by normal tissue. If so, laser spectroscopy might offer a way to positively diagnose the disease in living patients.

Feld envisions the laser-based techniques as "tools that may help doctors make more rapid and better decisions in the treatment of patients." The general approach, he comments, "is consistent with today's trend of less-invasive diagnosis."—LAURA VAN DAM

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WHEN BAD THINGS HAPPEN TO GOOD FACTORIES

Last March, when workers at two Dayton, Ohio, brake factories went on strike, the ensuing paralysis of General Motors plants across North America drove home a point that Stanley Gershwin has been trying to make for years: random disruptions, even

minor ones, can propagate across a manufacturing system, causing massive headaches. The strike at the brake plants—in protest against GM's practice of buying from nonunion sources—caused the automaker's deliberately lean inventories of brakes to dry up quickly. More than 177,000 GM workers were laid off. Parts suppliers, idled by the shutdowns, laid off tens of thousands more. By the end of the 16-day strike, economists were putting the cost to U.S. productivity at \$5–7 billion.

Gershwin, who is associate director of the MIT Laboratory for Manufacturing and Productivity, doesn't fault GM for keeping inventories low. Strikes, he says, are rare events that manufacturers can't necessarily plan for. But the nasty business in Autoland illustrates the value of adequate buffers. "Buffers are like shock absorbers," says Gershwin. "When there's a disruption in producing one part, they prevent the damage from spreading to other areas of a production process."

Exactly what level of inventory is sensible for a given manufacturing operation is a complex issue. In fact, Gershwin says, the whole question of how to compensate for disruptions is one that baffles many manufacturers. But just as there are ways to minimize disruptions (by boosting routine maintenance, for example), companies can take steps to keep a factory humming when random events *do* happen—when

machines break down, workers get sick, or parts fail to arrive.

Gershwin and his colleague Mitchell

Burman, a recently graduated PhD student in Gershwin's research group within MIT's Leaders for Manufacturing Program, believe that difficulty in coping with routine disruptions arises because factory design tends to be less rigorous



*Production lines
don't always run like
clockwork, as Lucy
and Ethel learned
the hard way.*

than other branches of engineering. "Certainly factories are complicated," says Gershwin, "but no more so than other complicated things like computers or automobiles or airplanes. Somehow a culture has developed that views factories as different, as much more intractable kinds of systems." As a result, he says, factory designers rely heavily on intuition. "But that intuition is not guided by a solid study of science the way an engineer's intuition about the behavior of fluids is based on 200 years of fluid mechanics."

Fads and Foibles

Without a firm foundation of understanding, manufacturers often misapply various fads or theories that are meant to boost efficiency. Consider the wildly popular "just in time" concept. The theory's emphasis on cutting inventory does save space and allow manufacturers to respond faster to market demands, according to the MIT researchers. The danger lies in taking the concept too literally. "Reducing inventory to nothing can cause more damage than having too much inventory," says Burman. Decisions about how much inventory each machine on an assembly line needs are complicated by tradeoffs between the cost of inventory and the cost of delays. Burman has developed a computer algorithm to weigh such tradeoffs, and now heads a consulting firm, Analytics, Inc., in Chestnut Hill, Mass., that helps companies sort through these and other production issues. As a crude rule of thumb, however, Gershwin suggests that the ideal amount of inventory is proportional to the length of the most common disruptions: if the breakdown of a certain trouble-prone machine usually takes three hours to fix, an assembly line should have three hours' worth of inventory to avoid grinding to a halt.

Disruptions are felt most keenly when companies succumb to another misconception: higher utilization is always better. "People think that once you've invested all this money in capital equipment, the factory should be run at 100

percent of capacity," says Burman. But suppose a company's promises to customers assume that products will be turned out at 100 percent of capacity, and a machine outage causes production to fall to 90 percent during a certain week. Not only will 10 percent of the customers be unhappy that week, but the plant will be 10 percent behind indefinitely. "Because you can't exceed capacity, you can never catch up," says Burman. Gershwin concludes: "You need a strategic amount of extra capacity to serve as a buffer, just as you need a strategic amount of inventory."

Another risky proposition, the researchers say, is the idea that each step in an assembly process should take the same amount of time. Manufacturers often try to "balance" their production lines, adjusting the speed of each operation in an effort to keep parts moving like clockwork from one machine to the next. A good idea in principle, says Burman, "but it's based on the assumption that nothing ever fails and everything moves perfectly." Each time a machine unaccountably speeds up or slows down, a bottleneck occurs. In a process with a large number of steps, "you can have bottlenecks bouncing all over the place." A factory would need extremely sophisticated logic to track, and adequately compensate for, all these bottlenecks.

A simpler solution, according to Burman, is to identify the slowest machine, the one most likely to create a bottleneck, and let it serve as the "gate" that controls the flow of the assembly line. "This way," he says, "you have one traffic light on your street instead of fifty, and you can more reliably tell customers when you expect to get products out."

Ironically, one trend that can worsen disruptions is the growth of automation. "You can't simply buy more computers and more robots and expect better performance," says Gershwin. A company will often replace an old, slow machine with its gleaming high-tech counterpart,



Stanley Gershwin (left) and Mitchell Burman are convinced that factories would be more efficient if they were engineered as carefully as other complex systems such as computers.

yet fail to take into account the consequences of a breakdown. While a relatively simple machine can usually be fixed quickly and locally, Gershwin says, repairing a sophisticated computer-controlled machine may cost a day or more in downtime. "By investing in this high-tech machine, you've forced yourself either to put larger buffers around or to accept a lower production rate."

Automation can also go awry when robots are assigned tasks that are more accurately performed by humans. Building a robot that can adapt to irregularities is both difficult and expensive, says Gershwin. Toyota, for example, recently gave up on the idea of using robotic systems for the tricky task of installing engine blocks. A simple power-assist device controlled by a worker turned out to be a more reliable and flexible way of positioning engines in car bodies.

Despite such pitfalls, the researchers are quick to affirm that they are not against high-tech manufacturing; they just want factories to be more aware of the need to take into account the likelihood of disruptions. "We're not Luddites," says Gershwin. "What we're saying is that you have to take a sophisticated and careful view of these things, and think out the consequences."

—DAVID BRITAN

Trends

In a novel experiment, three-dozen metal tubes arranged vertically in a 50-foot-diameter ring bathe the shrubs growing inside with air containing high concentrations of carbon dioxide. Researchers conducting the test hope to determine whether existing plants have the ability to soak up excess atmospheric carbon from ever-increasing fossil-fuel burning and thus mitigate any potential effects of global warming.

Plants: A Secret Weapon Against Global Warming?

High in the Southern California backcountry, ecologist Walter Oechel surveys a thicket of shrubs, dwarf oak trees, herbs, and wildflowers in hopes of glimpsing what the region will look like in the middle of the twenty-first century. By then, many researchers expect that atmospheric accumulations of carbon dioxide (CO₂) from fossil-fuel burning will warm the globe enough to cause major climate changes. But Oechel, director of the Global Change Research Group at San Diego State University (SDSU), wonders if the world's plants, including those in this high chaparral, will intervene by soaking up excess carbon from the atmosphere to grow thicker trunks and more leaves.

To answer that question, Oechel is exposing the vegetation in the ecosystem here at SDSU's Sky Oakes Biological Field Station to elevated levels of CO₂. The experiment, which resembles the

ancient monument Stonehenge, entails encircling the plants with a 50-foot-diameter ring of 36 metal tubes erected vertically on a mountain slope. Gas from a tank of liquid CO₂ is blown through the tubes and over the vegetation by a computer-controlled turbine system. The computer receives information about wind speed and direction from weather vanes, and opens and shuts valves to ensure that the plants receive a constant flow of air containing 550 parts of CO₂ per million. That concentration—double CO₂ levels that existed at the turn of this century and one-third more than today's levels—is the amount many researchers predict will be common by the year 2050.

The open-air experiment allows Oechel to take advantage of the natural environment as much as possible—including the effects of rain, wind, and animals—to more accurately gauge how much the physiological capacities of plants can be stretched. Each month, his team enters the test plot to measure the thickness of stems and the leaves' size and number, as well as the amount of CO₂ a plant is absorbing for use in pho-

tosynthesis. The first few months of the test have shown that shrubs inside the ring are taking up about one-third more CO₂ than nearby wild plants, though Oechel says it's too soon to predict their ultimate carbon-storage capacity. However, in more limited experiments that exposed chaparral plants to elevated CO₂ in his university lab, Oechel found the carbon-storage capacity of the shrubs, which had experienced accelerated growth, rose some 56 percent in 10 months.

Oechel believes that in other semi-arid climates featuring dry summers and wet winters—such as the U.S. Southwest, southern Europe, North Africa, Chile, Australia, and South Africa—vegetation should behave similarly. Using vegetation and land-area figures and extrapolating his preliminary results, he estimates the plants and soils in these regions could sop up and store perhaps an additional 100 billion metric tons of carbon from the air, a dramatic amount considering that industrial sources add 6 billion tons of carbon to the atmosphere each year.

When desert soils and shrubs are con-

sidered, the CO₂-storage capacity of vegetation swells further. Oechel estimates that the semi-arid and arid ecosystems together could hold a total of 400 billion tons of carbon.

Estimates of the carbon-storage capability of forests in other regions of the globe, such as in the high latitudes and the lush tropics, will have to wait. Indeed, experiment rings would have to be so tall and so large (to loom over the trees) and so extensive (to encompass a richer inventory of plants) that they would be prohibitively expensive and difficult to design, explains Stephen Schneider, a climatologist at Stanford University. Moreover, it might require decades to understand how the slow-growing trees in these regions change as atmospheric concentrations of CO₂ rise, he says.

Oechel expects to run his test for 10 years to study subtle effects in the ecosystem—such as increased microbial growth, since microbes could store still more carbon—and determine which plants might absorb the most CO₂ in a carbon-rich atmosphere over the years. He also plans to compare the results with growth rates of trees in the Tuscany region of Italy, where trees have been exposed to elevated levels of CO₂ escaping from an underground spring.

Other scientists have been conducting similar experiments. Duke University ecologist Boyd Strain has found that loblolly pines on a North Carolina tree plantation exposed to CO₂-enriched air have grown 90 percent larger than normal over the past three years. And in Arizona, Bruce Kimball, an agricultural scientist for the U.S. Department of Agriculture, has found that cotton, when exposed to elevated CO₂, shows a 40 percent rise in bud yield and plant bulk while wheat grows an additional 20 percent.

Once the vegetation's response is better documented, it can be incorporated into computer models of global climate, Oechel says. These models now attempt to predict future climate changes based primarily on how the oceans and atmosphere behave, he says, but as yet take little account of the influence of vegetation.

—DAVID GRAHAM

A Microgram of Prevention

The science is clear and heartening: up to three-quarters of two of the most common and severe birth defects—spina bifida (a protrusion of the spinal cord through the spine) and anencephaly (a congenital absence of part or all of the brain)—could be prevented if pregnant women consumed enough folic acid, a B vitamin found in many dark, leafy greens. Accordingly, after two years of deliberation, the federal Food and Drug Administration (FDA) recently required that folic acid be added to all grains sold in the United States, the first time the government has mandated that manufacturers fortify food with a vitamin or mineral since 1975, when vitamins such as niacin and riboflavin were added to cereal grains.

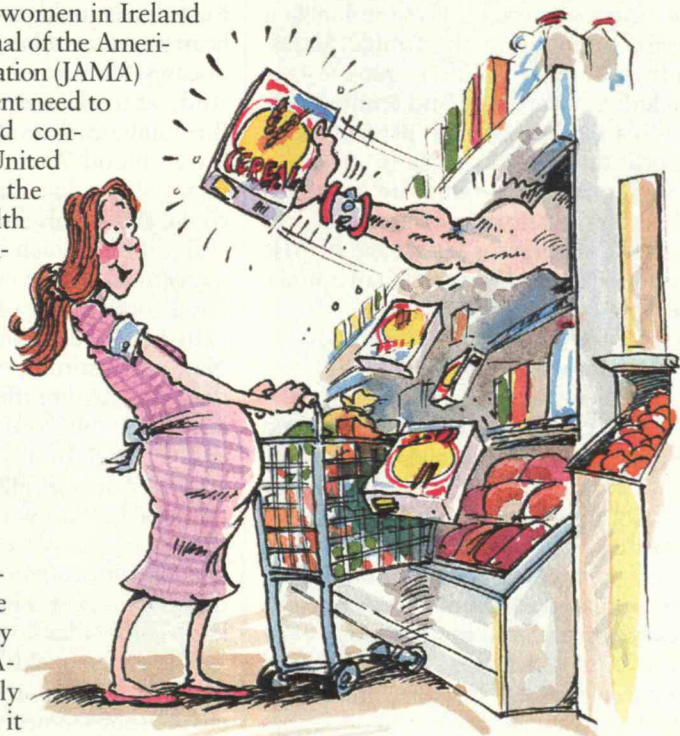
The decision comes after a host of studies has established a connection between so-called folate levels in the mother's blood and neural-tube (brain and spinal cord) defects in developing embryos. Most recently, a large four-year study of pregnant women in Ireland prompted the Journal of the American Medical Association (JAMA) to declare an "urgent need to increase folic acid consumption" in the United States. Similarly, the U.S. Public Health Service and the Centers for Disease Control (CDC) have long recommended fortifying grains with the substance.

Still, the FDA's fortification plan for folic acid has earned the agency widespread criticism. Many in the medical community argue that the FDA-required level is only a fraction of what it

should be. For example, Roger Stevenson, research director at the South Carolina-based Greenwood Genetic Center who is conducting a longitudinal study for CDC of folate levels among residents of South Carolina, complains that the FDA's new fortification levels for folic acid are "too low, too arbitrary, and not based on good science."

The FDA is requiring that 140 micrograms (millionths of a gram) of folic acid be added to every 100 grams of grain (about 3.5 ounces) sold in the United States. Stevenson points out that the two government agencies who have studied the issue—CDC and the U.S. Public Health Service—have recommended since 1992 that women of childbearing age receive a minimum of 400 micrograms of folic acid daily to reduce their risk that any pregnancies will result in children with neural-tube defects. Ensuring that women receive these levels, Stevenson and others contend, would mean fortifying grain at levels three to four times the new FDA requirements.

The issue is difficult because the nervous system of the developing embryo



forms within the first 28 days of conception. Thus, even if health practitioners encouraged pregnant women to increase their intake of folic acid through diet or vitamin supplements, this advice would usually come too late to be effective: half of all pregnancies in the United States are unplanned and therefore presumably not even discovered until after this crucial period of development.

Studies show that, on average, women in the United States now receive only half the recommended minimum allowance, and that they are poorly informed about the benefits of folic acid to their offspring. For example, a CDC-funded Gallup survey of women from the ages of 18 to 45 released last year by the March of Dimes found that only 15 percent of the more than 2,000 women interviewed were aware of the CDC's recommendation. Half had never even heard of folic acid. Of those who had, only 9 percent knew that it helped prevent birth defects, and less than half could name even one folic-acid-rich food.

Meanwhile, neural-tube defects such as spina bifida and anencephaly occur in one out of every 1,000 of the 4 million births annually in the United States. Advances in prenatal screening tests—including ultrasound and amniocentesis—can identify a high percentage of neural-tube defects early in the pregnancy, offering parents the option of abortion. But the promise that folic acid can so easily prevent at least half of these 4,000 cases has heartened many public health advocates.

Optimism vs. Caution

"It's the cheapest prevention we could ever dream of," Stevenson says of folate fortification, likening it to previously successful fortification efforts such as the addition of iodine to salt, which has largely prevented goiter, and the addition of fluoride to drinking water, which has greatly reduced tooth decay. "Only once in a generation," says Richard Johnston, medical director of the March of Dimes Birth Defects Foundation, does

such an opportunity arise "for mass prevention of serious and common birth defects."

The latest research suggests that folic acid has powerful benefits for adults as well. Higher folate levels in the blood have been shown in preliminary studies to lower the plasma concentration of homocysteine, an emerging risk factor for heart disease. More research is now



under way, but one well-respected analysis by a team at the University of Washington has suggested that increased folate levels could result in 50,000 fewer heart attacks, strokes, and other vascular diseases. Similar research, including one study at the University of Alabama at Birmingham, has also indicated that lower blood levels of homocysteine might also reduce the risks of cervical, colon, and rectal cancers.

But despite such optimistic reports, many urge caution on the issue of fortifying foods. James Mills, chief of the pediatric epidemiology section at the National Institutes of Health, explains that while no dire effects of folic acid are known, he still worries about raising the entire population's levels of any substance. "Some people think any level of folic acid is safe. I would not subscribe to that until I saw a large population study." Unfortunately, he adds, "those data do not exist. The fact is, very little is known about large doses of folic acid."

The problem, Mills explains, is that fortification at a level high enough to ensure that women get 0.4 milligrams

daily means that some people will be getting considerably more. "We just don't know what people will eat," he says. "Pregnant women might eat a sandwich a day, but it is not farfetched to think of teenagers eating 6 pieces of bread at a sitting."

What is known, and what lends credence to those who urge caution, is that folic acid, a B vitamin, can mask the telltale signs of anemia such as lethargy associated with a deficiency of vitamin B-12, a condition particularly prevalent among the elderly that can ultimately cause irreversible neurological damage. In one analysis, medical researcher Patrick Romano of the University of California at Davis calculated that even the modest level of folic acid proposed by the FDA, while preventing 300 neural-tube defects annually, would put more than 3 million people over the age of 50 at risk of masking the most obvious symptoms of B-12 deficiency.

Despite these concerns, other doctors contend that anemia is already masked in 25 percent of all cases of B-12 deficiency. They stress that greater vigilance is already needed to detect these cases and that, even though screening the B-12 blood levels of everyone over age 50 would be an expensive proposition, diagnostic methods do exist to detect B-12 deficiency.

Despite his reservations, Mills, for one, is happy with the decision to require a modest level of fortification. "If we knew how to reach women of childbearing age directly," he says, "I wouldn't want to see any folic acid added to our diet. But I think the FDA has arrived at the best compromise."

Mills's vote of confidence should offer some comfort to FDA Commissioner David Kessler, who has called the debate over folic acid fortification one of the more difficult scientific and policy matters he has confronted. Everyone would love to eradicate all birth defects, Kessler told a meeting of the March of Dimes last year, but when "we fortify the food supply for 250 million Americans, we have to make sure we get it right."

—SETH SHULMAN

Driving Simulators for the Elderly

It's no secret that as drivers become elderly they are more likely to be involved in accidents: according to the National Highway Traffic Safety Administration, drivers over the age of 70 experience a higher number of crashes per mile driven than any age group except 16-to-20-year-olds. A major factor behind such poor driving records, researchers say, is the diminished capacity of elderly people to absorb visual information, which occurs as the transmission of neural impulses slows with age.

Unfortunately, the license-renewal tests intended to screen out unsafe drivers often ignore this factor. Because most state motor vehicle departments test only for visual acuity—the ability to resolve small details in the distance—other perceptual difficulties, even dementia, can slip by, says Cynthia Owsley, a professor of ophthalmology at the University of Alabama at Birmingham.

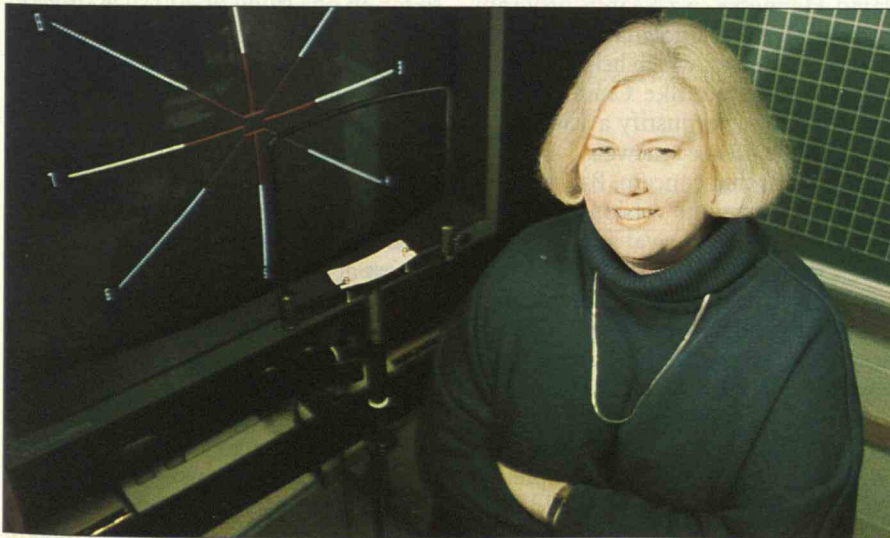
To remedy the situation, Owsley and researchers at the Center for Mobility Enhancement in the Elderly at Western Kentucky University have been working to develop a new computer-based driving simulator that they say can identify

older drivers with visual-processing difficulties that are most likely to cause car crashes. Perhaps more important, the developers claim, the simulator can be used as a training tool to help these drivers compensate for their perceptual limitations and improve their driving performance.

The simulator was designed to measure what researchers call our “useful field of view”—the area of visual information that we can process in a brief glance. When this range is reduced, says Owsley, the driver has problems locating other cars and resolving driving situations on the periphery. The problem is not a result of diminished peripheral vision, though that might be a contributing factor, she explains. Rather, when visual processing abilities decline, objects on the periphery, even when they can be seen, are the first to be ignored.

“When we're driving,” says Owsley, “we're trying to do two things at once: pay attention to what's down the road and keep an eye on what's around us.

Karlene Ball and her colleagues at Western Kentucky University have developed a computer-based simulator that they say can identify drivers who have visual-processing difficulties that are most likely to cause car crashes.



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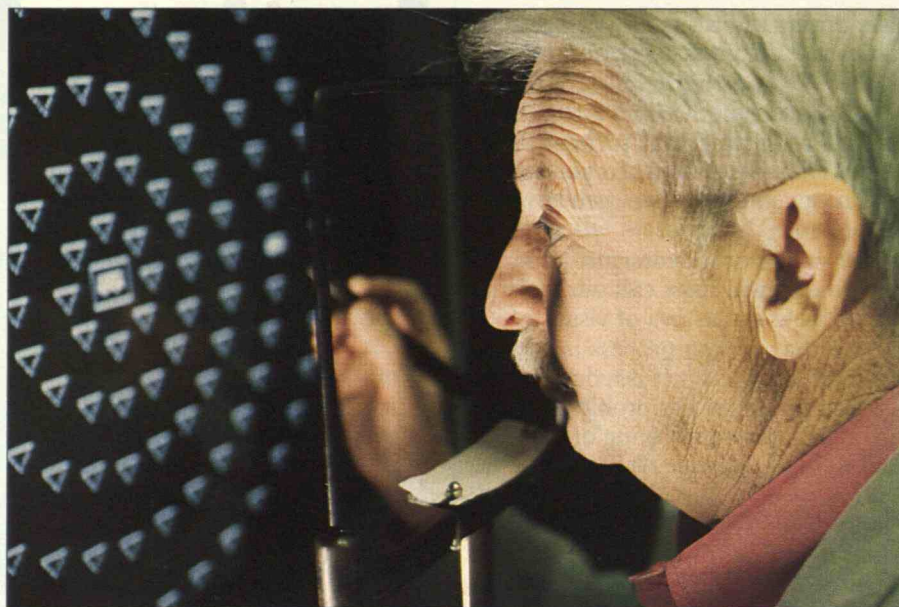
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The simulator can train elderly drivers to compensate for their inability to process information concerning objects on the periphery—the main reason for their poor driving performance—and cut their percentage of hazardous driving maneuvers in half.

In fact, she notes that studies of older drivers suggest that many of their accidents occur at intersections, and failing to process visual details at the periphery seems to be a common factor.

Retraining Dangerous Drivers

The simulator asks drivers to recognize what's happening on the road ahead of them and around them while filtering out irrelevant visual details. During the 15-minute test, subjects gaze at a large television while targets in front of them and at the edges of the screen flash on and off for less than a quarter of a second—all while little triangles are added to the scene as a distraction. According to Owsley, these objects simulate the way vehicles, signs, pedestrians, and other objects appear to us when we're driving at highway speeds. Subjects are then asked to identify each of the targets and their location.

"There's very good evidence to suggest that people who fail this type of test should not be driving," says Karlene Ball, a psychology professor at Western Kentucky. She found that older drivers whose "useful field of view" was reduced by 40 percent or more were 16 times more likely than others to have

been involved in crashes in the previous five years. Follow-up studies found that only 26 percent of older drivers with a similarly reduced field of view remained accident-free in the ensuing three years, compared with 97 percent of older drivers with normal vision.

Unfortunately, the simulator test is impractical for the high-volume requirements of most state motor vehicle departments. "We process tens of thousands of people a day, so every minute of testing costs us millions of dollars," says David Hennessy, a research program specialist at the California Department of Motor Vehicles, which helped test the simulator. A state like California, he says, "could never justify a 15-minute test to screen license renewals."

To address that concern, Ball is developing a three-minute version of the test for use in license-renewal screening. "It gives a grosser measure of performance, sort of like a pass-fail grade, rather than an absolute score," she says. "But that should be adequate for [the testers'] purposes since they just want to know who is impaired." In contrast, the reason she developed the original version, she says, "was to find out why some people are impaired and to see if we could help them improve their skills."

In fact, one encouraging finding in Ball's research is that some drivers with field-of-view limitations can improve their skills with training. Through practice, subjects learned to process information about targets on the periphery sooner and to "cut the percentage of hazardous driving maneuvers in half." Moreover, the elders retain this improved ability "for one year," she says, "and we're starting to follow people longer than that."

Ray Peck, chief of research and development at the California Department of Motor Vehicles, cautions that while these results look promising, researchers need to demonstrate that improved performance in the simulator will translate into better driving on the road. "You may become more skillful on the test," he says, "but does that mean you're going to see more stop signs and react in time to avoid an accident?"

The next step for Ball and her colleagues is to study the driving performance of elderly drivers before and after training on the simulator. She says that so far, in one study of 400 such drivers, licensed driving evaluators who went out on the road with the drivers found that people were able to stop, on average, 20 feet sooner after training. The drivers also committed less than half the number of dangerous maneuvers that they did before training.

Ball is also trying to set up training centers at a variety of locations besides motor vehicle departments, such as occupational-therapy practices and eye-care centers. "People might be more willing to try the simulator if they knew it was designed to improve their driving rather than to lead them to lose their license," she says. "Our goal is to enhance mobility of elderly people, not restrict it."

—MARK WARD

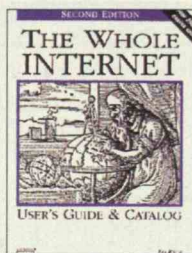
Dvorak Keyboards: The Typist's Long-Lost Friend

After spending several years in the 1930s studying the layout of conventional typewriter keyboards, August Dvorak, a professor of education at the University of Washington, recognized that, in terms of efficiency, the so-called QWERTY layout was a loser. Designed in the 1870s to slow typists and thus prevent the first typewriters from jamming, the convention places the most common letters outside the "home row," where the fingers rest between keystrokes and keys are easiest to strike.

In 1936, Dvorak patented a new keyboard layout based on his time-and-motion studies, positioning the most common letters in the home row so that the left hand would type the vowels, a, o, e, u, i, and the right hand would type the most common consonants, d, h, t, n, s. He then spent the rest of his life promoting the notion that his logical keyboard would not only increase typing speed and accuracy but make typing easier on the fingers, something that was particularly important in the era of manual typewriters.

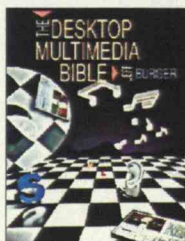
Today Dvorak's invention is little more than a technological footnote. Businesses willing to spend thousands of dollars refitting workstations and rehabilitating injured workers have shown no interest in an ergonomic keyboard that could be expected to improve performance and reduce repetitive strain injuries, and whose only cost would be for retraining.

But Dvorak advocates say the time has come to consider making a switch, since those who study typing confirm Dvorak's advantages. For example, Scot Ober, a professor in the department of business education and office administration at Ball State University, recently found that "Dvorak users typed 15 to 25 percent faster than standard users on timed writings and 25 to 50 percent faster on realistic tasks such as the production of letters, reports, and tables."



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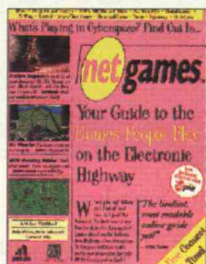
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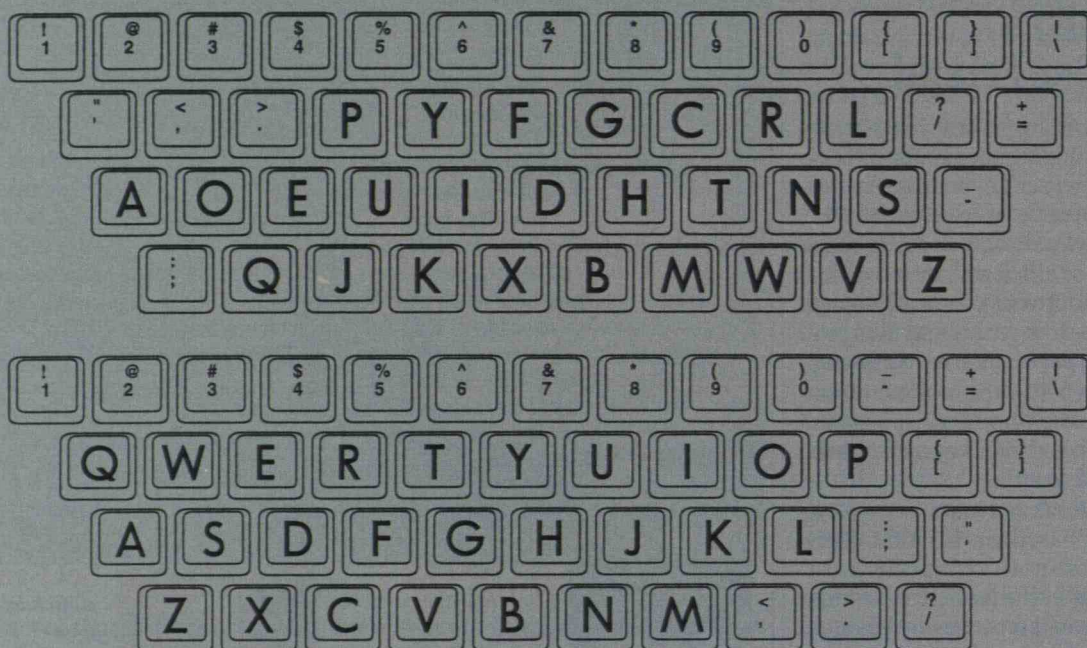
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Studies show that typists using the Dvorak keyboard (top) type 15 to 25 percent faster and make 37 percent fewer finger movements than those using the conventional QWERTY keyboard (bottom). Improved efficiency results from Dvorak's more logical layout, which includes placing the most commonly used letters on the "home" row where the fingers rest between keystrokes.

He also discovered that Dvorak typists make 37 percent less finger movements than QWERTY users.

The most obvious point of departure for Dvorak is the number of common letters on its home row that are not on QWERTY's: a, o, e, u, i, t, and n. But Dvorak's redesign also redistributes the work to give 56 percent of the load to the right hand, which is usually stronger. QWERTY, in contrast, gives the right hand 43 percent of the keystrokes.

Dvorak also awarded the highly adept forefinger and middle fingers of each hand the largest roles. Compare the difference: on QWERTY's home row, these fingers type d, f, j, and k; in Dvorak, they type the more frequently used e, u, h, and t.

Finally, Dvorak examined common two-letter sequences, or digraphs. Using one finger to type these in succession is difficult. But the QWERTY layout is full of common one-finger digraphs, including rt, tr, ed, de, fr, sw, ty, gy, and lo. Dvorak, in contrast, has a few less frequently used ones, such as py and gh.

The result is a keyboard that has bro-

ken all speed records. In fact, in the early 1970s, Oregon transcriptionist Barbara Blackburn set an all-time record of 170 words per minute using Dvorak, a feat published in the 1975 *Guinness Book of Records*. But 10 years later, the book's publisher dropped the Dvorak record and now posts a QWERTY record of 158 words per minute.

Despite his scientific approach, professor Dvorak clearly failed to calculate the staying power of a system entrenched in both hardware and the human skull. By the time he introduced his layout, QWERTY had already stood as the standard for half a century. And the Dvorak layout, for all its advantages,

could not gain a credible market share.

It was a classic chicken-and-egg problem. Only a few typewriter manufacturers bothered building Dvorak machines, and only a few instructors bothered to teach it. Consequently, the market stagnated because so few people had access to Dvorak machines and training.

But as in many lost causes, Dvorak attracted its devoted followers, who, in 1978, formed Dvorak International in Poultney, Vt., as a clearinghouse for information on the keyboard. According to its president, Steven Ingram, the group "provides information to people who are trying to find an alternate keyboard. These people assume that the keyboard they're using was designed for a good reason," he says. "Then they learn that it was actually designed for a bad reason."

One of Dvorak International's major roles is helping distribute free software that instantly "remaps" Macintosh and PC keyboards between QWERTY and Dvorak. Indeed, this program has undermined one long-standing objection to Dvorak—that it required a separate

investment in machinery. Now, Dvorak and QWERTY users can coexist on the same machine. Unbeknownst to most Windows users, Dvorak is also available in that operating system (versions 3.1 and Windows 95).

In the late 1980s, advocates gained a new reason for using the Dvorak keyboard: the growing concern about repetitive strain injuries, or cumulative trauma disorders (CTDs). These injuries of the hands and arms—including tendinitis and carpal tunnel syndrome—usually stem from overuse of the muscles, tendons, and joints.

The conventional approach to reducing CTDs is to give typists more rest time and provide better furniture, wrist rests, and sometimes keyboards adapted to curves of the human hand. But when Rick Robertson, a professor in the Department of Physical Education and Rehabilitation at the University of Pittsburgh, studied typing practices in “production typing” shops—such as those run by insurance or phone companies—he found that these measures were inadequate. “I visited one facility that was doing everything properly,” he says. “They had spent maybe a hundred thousand dollars on workstations and furniture. But they still had a 21 percent incidence of carpal tunnel syndrome or another debilitating strain injury.”

Robertson wanted to systematically compare the injuries of Dvorak and QWERTY typists. But because there are too few Dvorak users to enable a meaningful long-term study, he opted to simply compare the effects of typing with both keyboards on tendon movement in the arm, assuming that more travel would exacerbate repetitive strain injuries. His tests showed that Dvorak reduced tendon movement by 6 to 10 percent. “That doesn’t sound like much,” he says, but it can make a significant difference to people who do a lot of typing.”

Still, even with this expected reduction in repetitive strain, an estimated 37 percent reduction in finger movement, and dramatically speedier typing, significant numbers of people have not been per-

sueded to adopt the Dvorak keyboard.

The fact is that learning to use a Dvorak keyboard takes a considerable amount of time and effort. But the problem may be less than insuperable. In fact, the U.S. Navy once experimented with Dvorak keyboards and documented some encouraging results. In 1944, it gave experienced typists an average of 83 hours of training in Dvorak. Its report, which is still referenced by Dvorak’s advocates, concluded that “the average time for the typists to reach their Standard Keyboard net speed was 52 hours.” At the end of the training, performance on Dvorak keyboards bested that on standard keyboards “by an average of 68 percent in accuracy and 74 percent in net typing speed.” Furthermore, the typists learned Dvorak almost nine times as quickly as they had previously learned QWERTY and “were unanimous in

their approval of the simplified keyboard” because it was “easy to learn,” “more accurate,” and “less fatiguing.”

Such results seem to indicate that retraining, though expensive, would pay off in just a few months for many workplaces. Yet when Carol Adukaitis, as part of the research for her 1990 PhD dissertation at Temple University, studied whether managers in *Fortune* 500 companies were allowing employees to use Dvorak, she found that none were, even on a trial basis, and none were seriously considering it. —Contributing writer DAVID TENENBAUM has been using Dvorak keyboards for the past five years but has failed to persuade anyone else to make the switch.

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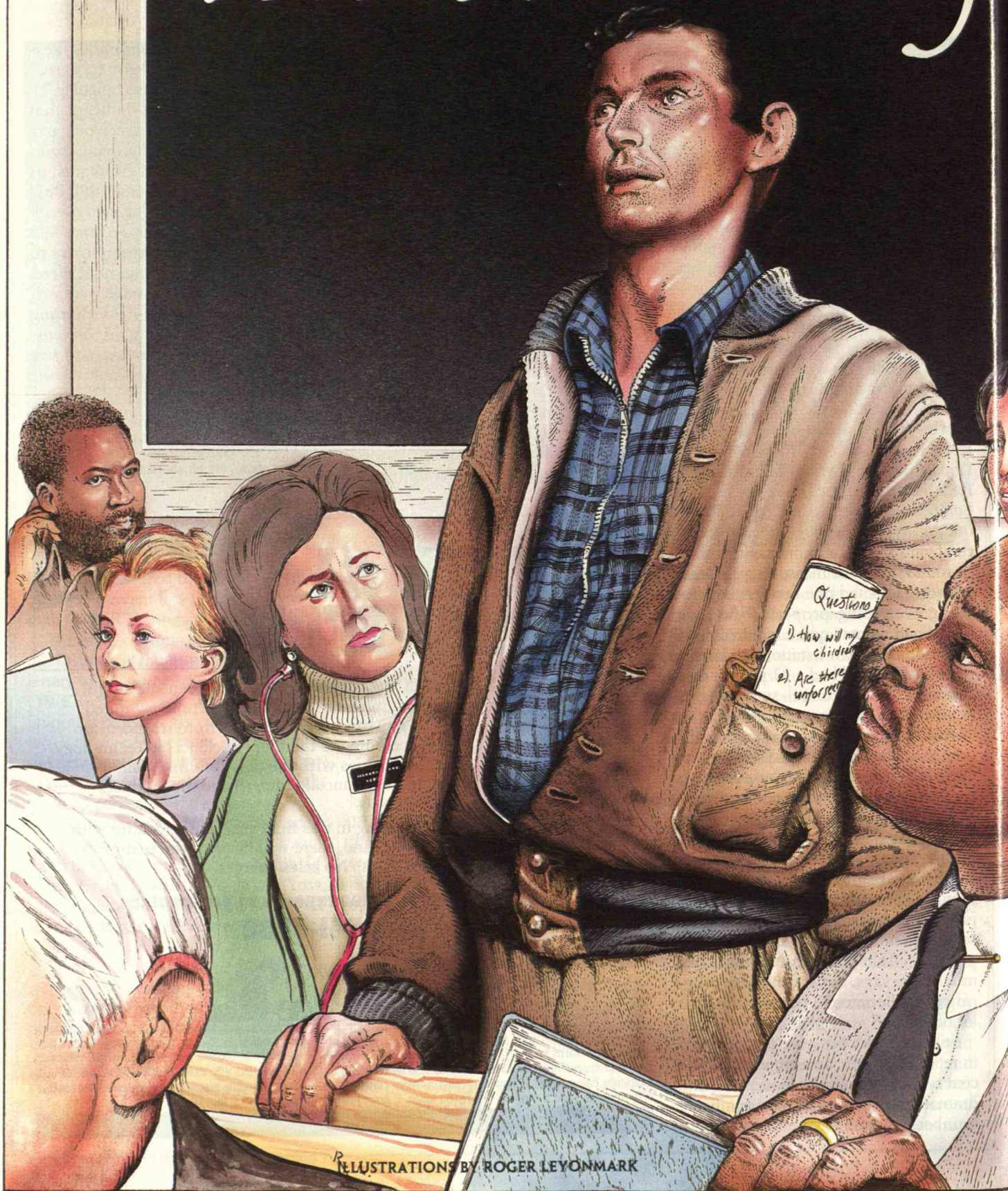


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Town Meetings



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on Technology

The "consensus conference," a recent Danish innovation, gives ordinary citizens a real chance to make their voices heard in debates on technology policy. And business and government, as well as the general public, could reap substantial rewards.



IN A DEMOCRACY, it normally goes without saying that policy decisions affecting all citizens should be made democratically. Science and technology policies loom as grand exceptions to this rule. They certainly affect all citizens profoundly: the world is continuously remade with advances in telecommunications, computers, materials science, weaponry, biotechnology, home appliances, energy production, air and ground transportation, and environmental and medical understanding. Yet policies are customarily framed by representatives of just three groups: business, the military, and universities. These are the groups invited to testify at congressional hearings, serve on government advisory panels, and prepare influential policy studies.

BY RICHARD E. SCLOVE

According to conventional wisdom, the reason for this state of affairs is that nonexperts are ill-equipped to comment on complex technical matters and probably wouldn't want to anyway. But the success of an innovative European process dubbed the consensus conference has begun to shed new light on the subject. Pioneered during the late 1980s by the Danish Board of Technology, a parliamentary agency charged with assessing technologies, the process is intended to stimulate broad and intelligent social debate on technological issues. Not only are laypeople elevated to positions of preeminence, but a carefully planned program of reading and discussion culminating in a forum open to the public ensures that they become well-informed prior to rendering judgment.

Both the forum and the subsequent judgment, written up in a formal report, become a focus of intense national attention—usually at a time when the issue at hand is due to come before Parliament. Though consensus conferences are hardly meant to dictate public policy, they do give legislators some sense of where the people who elected them might stand on important questions. They can also help industry steer clear of new products or processes that are likely to spark public opposition.

Since 1987 the Board of Technology has organized 12

well as the European Union, Canada, New Zealand, and Australia, are actively considering consensus conferences as well.

Ironically, the process is gaining popularity just as the U.S. Congress has abolished its Office of Technology Assessment (OTA), whose establishment in 1972 helped motivate Europeans to develop their own technology assessment agencies. But the truth is that when the OTA faced the chopping block, those rallying to its defense were primarily a small cadre of professional policy analysts or other experts who had themselves participated in OTA studies—hardly a sizable cross-section of the American public. By contrast, a consensus conference format, which engages a much wider range of people, holds the potential to build a broader constituency familiar with and supportive of technology assessment. And there is no reason why the United States could not adapt the process.

Framing the Issues

To organize a consensus conference, the Danish Board of Technology first selects a salient topic—one that is of social concern, pertinent to upcoming parliamentary deliberations, and complex, requiring judgment on such

A focus on the social issues surrounding technology becomes more likely when expert testimony is integrated with the perspectives of ordinary citizens.

consensus conferences on topics ranging from genetic engineering to educational technology, food irradiation, air pollution, human infertility, sustainable agriculture, and the future of private automobiles. And the board's achievements have recently led to new incarnations of the Danish process—twice in the Netherlands and once in the United Kingdom. Other European nations, as

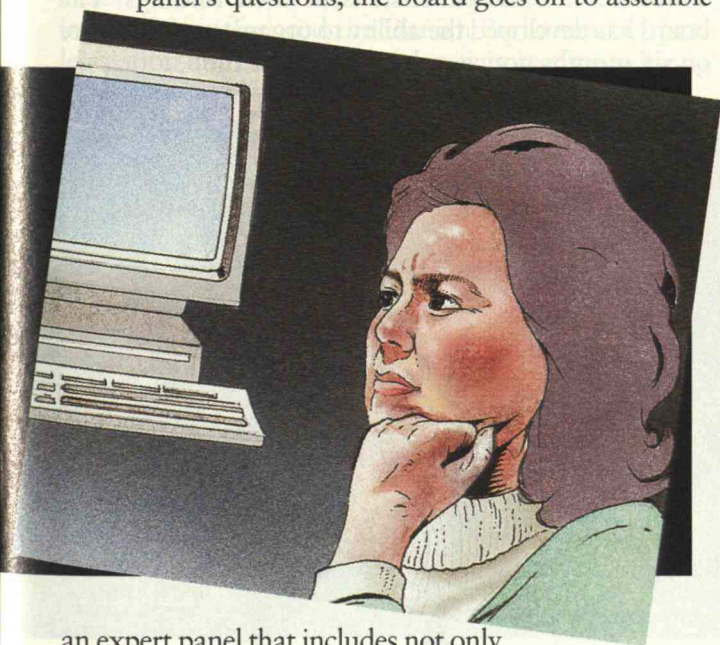
diverse matters as ethics, disputed scientific claims, and government policy. The board has also found that topics suited to the consensus conference format should be intermediate in scope—broader than assessing the toxicity of a single chemical, for instance, but narrower than trying to formulate a comprehensive national environmental strategy. The board then chooses a well-balanced steering committee to oversee the organization of the conference; a typical committee might include an academic scientist, an industry researcher, a trade unionist, a representative of a public interest group, and a pro-

RICHARD E. SCLOVE is executive director of the Loka Institute, a nonprofit organization based in Amherst, Mass., that is concerned with the social effects of science and technology (e-mail Loka@amherst.edu). He is the author of *Democracy and Technology* (Guilford Press, 1995).

ject manager from the board's own professional staff.

With the topic in hand and the steering committee on deck, the board advertises in local newspapers throughout Denmark for volunteer lay participants. Candidates must send in a one-page letter describing their backgrounds and their reasons for wanting to participate. From the 100 to 200 replies that it receives, the board chooses a panel of about 15 people who roughly represent the demographic breadth of the Danish population and who lack significant prior knowledge of, or specific interest in, the topic. Groups include homemakers, office and factory workers, and garbage collectors as well as university-educated professionals. They are not, however, intended to comprise a random scientific sample of the Danish population. After all, each panelist is literate and motivated enough to have responded in writing to a newspaper advertisement.

At the outset of a first preparatory weekend meeting, the lay group, with the help of a skilled facilitator, discusses an expert background paper commissioned by the board and screened by the steering committee that maps the political terrain surrounding the chosen topic. The lay group next begins formulating questions to be addressed during the public forum. Based on the lay panel's questions, the board goes on to assemble



an expert panel that includes not only credentialed scientific and technical experts but also experts in ethics or social science and knowledgeable representatives of stakeholder groups such as trade unions, industry, and environmental organizations.

The lay group then meets for a second preparatory weekend, during which members, again with the facilitator's help, discuss more background readings provided by the steering committee, refine their questions, and, if they want, suggest additions to or deletions from the expert panel. Afterward, the board finalizes selec-

tion of the expert panel and asks its members to prepare succinct oral and written responses to the lay group's questions, expressing themselves in language that laypeople will understand.

The concluding public forum, normally a four-day event chaired by the facilitator who presided over the preparatory weekends, brings the lay and expert panels together and draws the media, members of Parliament, and interested Danish citizens. On the first day each expert speaks for 20 to 30 minutes and then addresses follow-on questions from the lay panel and, if time allows, the audience. Afterward, the lay group retires to discuss what it has heard. On the second day the lay group publicly cross-examines the expert panel in order to fill in gaps and probe further into areas of disagreement.

Once cross-examination has been completed, the experts are politely dismissed. The remainder of that day and on through the third, the lay group prepares its report, summarizing the issues on which it could reach consensus and identifying any remaining points of disagreement. The board provides secretarial and editing assistance, but the lay panel retains full control over the report's content. On the fourth and final day, the expert group has a brief opportunity to correct outright factual misstatements in the report, but not to comment on the document's substance. Directly afterward, the lay group presents its report at a national press conference.

Lay panel reports are typically 15 to 30 pages long, clearly reasoned, and nuanced in judgment. The report from the 1992 Danish conference on genetically engineered animals is a case in point, showing a perspective that is neither pro- nor anti-technology in any general sense. The panel expressed concern that patenting animals could deepen the risk of their being treated purely as objects. Members also feared that objectification of animals could be a step down a slippery slope toward objectification of people. Regarding the possible ecological consequences of releasing genetically altered animals into the wild, they noted that such animals could dominate or out-compete wild species or transfer unwanted characteristics to them. On the other hand, the group saw no appreciable ecological hazard in releasing genetically engineered cows or other large domestic animals into fenced fields, and endorsed deep-freezing animal sperm cells and eggs to help preserve biodiversity.

Portions of lay panel reports can be incisive and impassioned as well, especially in comparison with the circumspection and dry language that is conventional in expert policy analyses. Having noted that the "idea of genetic normalcy, once far-fetched, is drawing close with the development of a full genetic map," a 1988 OTA study of human genome research concluded blandly that "concepts of what is normal will always be influenced by cultural variations"; in contrast, a 1989 Dan-

ish consensus panel on the same subject recalled the "frightening" eugenic programs of the 1930s and worried that "the possibility of diagnosing fetuses earlier and earlier in pregnancy in order to find 'genetic defects' creates the risk of an unacceptable perception of man—a perception according to which we aspire to be perfect." The lay group went on to appeal for further popular debate on the concept of normalcy. Fearing that parents might one day seek abortions upon learning that a fetus was, say, color blind or left-handed, 14 of the panel's 15 members also requested legislation that would make fetal screening for such conditions illegal under most circumstances.

This central concern with social issues becomes much more likely when expert testimony is integrated with everyday citizen perspectives. For instance, while the executive summary of the OTA study on human genome research states that "the core issue" is how to divide up resources so that genome research is balanced against other kinds of biomedical and biological research, the Danish consensus conference report, prepared by people whose lives are not intimately bound up in the funding dramas of university and national laboratories, opens with a succinct statement of social concerns, ethical judgments, and political recommendations. And these perspectives are integrated into virtually every succeeding page, whereas the OTA study discusses ethics only in a single discrete chapter on the subject. The Danish consensus conference report concludes with a call for more school instruction in "subjects such as biology, religion, philosophy, and social science"; better popular dissemination of "immediately understandable" information about genetics; and vigorous government efforts to promote the broadest possible popular discussion of "technological and ethical issues." The corresponding OTA study does not even consider such ideas.

When the Danish lay group did address the matter of how to divide up resources, they differed significantly from the OTA investigators. Rather than focusing solely on balancing different kinds of biomedical and biological research against one another, they supported basic research in genetics but also called for more research on the interplay between environmental factors and genetic inheritance, and more research on the social consequences of science. They challenged the quest for exotic technical fixes for disease and social problems, pointing out that many proven measures for protecting health and bettering social conditions and work environments are not being applied. Finally, they recommended a more "humanistic and interdisciplinary" national research portfolio that would stimulate a constructive exchange of ideas about research repercussions and permit "the soul to come along."

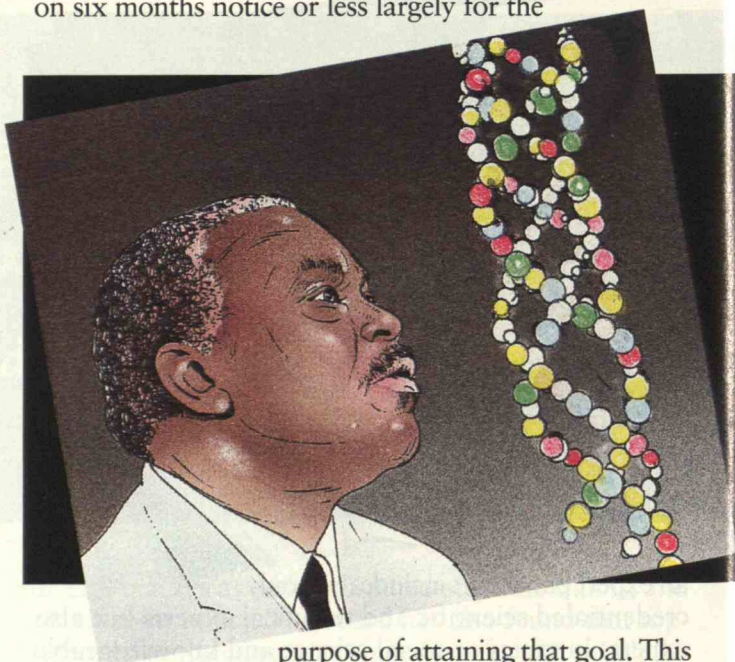
Not that consensus conferences are better than the

OTA approach in every possible way. While less accessibly written and less attentive to social considerations, a traditional OTA report did provide more technical detail and analytic depth. But OTA-style analysis can, in principle, contribute to the consensus conference process. For example, the 1993 Dutch consensus conference on animal biotechnology used a prior OTA study as a starting point for its own more participatory inquiry.

Timeliness and Responsiveness

Once the panelists have announced their conclusions, the Board of Technology exemplifies its commitment to encouraging informed discussion by publicizing them through local debates, leaflets, and videos. In the case of biotechnology, the board has subsidized more than 600 local debate meetings. The board also works to ensure that people are primed for this whirlwind of post-conference activity. For example, the final four-day public forums are held in the Parliament building, where they are easily accessible to members of Parliament and the press.

Nor is it any accident that the topics addressed in consensus conferences are so often of parliamentary concern when the panelists issue their findings. The board has developed the ability to organize a conference on six months notice or less largely for the



purpose of attaining that goal. This timeliness represents yet another advantage over the way technology assessment has been handled in the United States: relying mostly on lengthy analysis and reviews by experts and interest groups, the OTA required, on average, two years to produce a published report on a topic assigned by Congress. In fact, one complaint leveled by the congressional Republicans who argued for eliminating the agency was that the process it

employed was mismatched to legislative timetables. Upon learning about consensus conferences and their relatively swift pace, Robert S. Walker, Republican chair of the House Science Committee, told a March 1995 public forum that if such a process can "cut down the time frame and give us useful information, that would be something we would be very interested in."

The Board of Technology's efforts do seem to be enhancing public awareness of issues in science and technology. A 1991 study by the European Commission discovered that Danish citizens were better informed about biotechnology, a subject that several consensus conferences had addressed, than were the citizens of other European countries, and that Danes were relatively accepting of their nation's biotechnology policies as well. Significantly, too, Simon Joss, a research fellow with the London Science Museum who has conducted interviews on consensus conferences with Danish members of Parliament, has found the legislators to be generally appreciative of the process—indeed, to the point where several eagerly pulled down conference reports kept at hand on their office shelves.

And although consensus conferences are not intended to have a *direct* impact on public policy, they do in some cases. For instance, conferences that were held in the late 1980s influenced the Danish Parliament to pass legislation limiting the use of genetic screening in hiring

change of heart. The reasons are illuminating.

In conventional politics of technology, the public's first opportunity to react to an innovation can occur years or even decades after crucial decisions about the form that innovation will take have already been made. In such a situation, the only feasible choice is between pushing the technology forward or bringing everything to a halt. And no one really wins: pushing the technology forward risks leaving opponents bitterly disillusioned, whereas bringing everything to a halt can jeopardize jobs and enormous investments of developmental money, time, and talent. The mass movements of the 1970s and 80s that more or less derailed nuclear power are a clear example of the phenomenon.

By contrast, early public involvement and publicity—of the sort that a consensus conference permits—can facilitate more flexible, socially responsive research and design modifications all along the way. This holds the potential for a fairer, less adversarial, and more economical path of technological evolution. A representative of the Danish Council of Industry relates that corporations have benefited from their nation's participatory approach to technology assessment because "product developers have worked in a more critical environment, thus being able to forecast some of the negative reactions and improve their products in the early phase."

Early public involvement of the sort a consensus conference permits can help avoid the protest movements that often jeopardize jobs and investments.

and insurance decisions, to exclude genetically modified animals from the government's initial biotechnology research and development program, and to prohibit food irradiation for everything except dry spices. Manufacturers are taking heed of the reports that emerge from consensus conferences as well. According to Professor Tarja Cronberg of the Technical University of Denmark, Danish industry originally resisted even the idea of establishing the Board of Technology but has since had a

For example, Novo Nordisk, a large Danish biotechnology company, reevaluated its research and development strategies after a 1992 panel deplored the design of animals suited to the rigors of existing agricultural systems but endorsed the use of genetic engineering to help treat incurable diseases. The firm now wants to concentrate on work more likely to win popular approval, such as animal-based production of drugs for severe human illnesses.



The diverse group of 16 ordinary citizens who served as panelists for Britain's first consensus conference in May 1994 included a roadsweeper, an airline pilot, a caterer, and a nurse. Their job was to weigh the risks and benefits of genetically engineered plants.

Bringing It All Back Home

Finding suitable topics for U.S. consensus conferences would hardly be difficult; a variety of technically complex and socially significant issues currently on the federal agenda could work. One likely candidate would be the evolution of the information superhighway. The World Wide Web and other information systems promise to significantly affect everyone in our society, including many people who do not presently use computers and who are poorly represented in current deliberations on telecommunications policy.

Another good topic would be post-Cold War reorganization of the U.S. national laboratory system. All taxpayers finance that system, which is intended to function as a national resource. However, blue-ribbon commissions appointed to help chart the labs' future have focused on the concerns of scientists, the military, industry, and the communities immediately adjacent to the labs—not on the needs of the American public as a whole.

Moreover, the mechanisms for distributing lay panel reports and encouraging follow-on social debate are readily available in this country. They include the Internet and the League of Women Voters. Also, the Connecticut-based Study Circles Resource Center, the Public Agenda Foundation, and the Kettering Foundation are experienced in facilitating nonpartisan, public-affairs discussions across the United States—everything from study groups with four or five people to large community forums.

Of course, a lay panel composed of, say, 15 people would represent a feeble statistical sample in a nation whose population numbers 250 million. However, hear-

ing the considered views of a diverse group of 15 ordinary citizens would be a marked improvement over excluding the lay perspective entirely, which is the norm in most contemporary technology policy analysis and decision making. Skeptics could also point out that consensus may be much easier to attain in a small, fairly homogeneous nation such as Denmark. But it is not as if consensus is impossible here; U.S. juries routinely reach consensus on highly contested, complex legal disputes. And besides, the significant feature of the consensus conference model is not consensus itself but the cultivation of informed citizen judgment. The final report can and often does identify issues on which the panel is unable to reach agreement. The report from the 1993 Dutch consensus conference on animal biotechnology included majority and minority opinions. In fact, believing that consensus is not essential to the model at all, Dutch organizers renamed their variant simply a "public debate."

Consensus aside, would an ad hoc assemblage of U.S. citizens even be capable of deliberating together reasonably? There is some reason to think so. The intensive preparatory weekends that precede a public consensus conference help by letting lay panelists get to know one another and develop their ability to reason together. More to the point, key real-life trials have met with encouraging results. For instance, although Britain is populous and racially and socioeconomically diverse, panelists on the first U.K. consensus conference proved quite able to converse and work together.

And the Jefferson Center—a Minneapolis-based nonprofit organization that explores new democratic decision-making methods—has developed a deliberative

format, known as a "citizens jury[®]" process, that is similar in many ways to a consensus conference. In 1993, such lay panels formed working relationships sound enough to permit an examination of such contentious issues as national health care reform and federal budget restructuring. The panels' conclusions did not directly alter government policy, but they received enough media attention to influence public debate, and elected officials paid attention. Indeed, representatives from the budget jury were invited to discuss their proposals with the U.S. Senate Finance Committee.

As to the question of who should organize consensus conferences, European organizers stress the need to seek an institution that is—and will be perceived as—scrupulously impartial on the issues under debate, authentically committed to democratic deliberation, and of sufficiently high stature to attract strong media, popular, and government attention. Consider, for example, the Library of Congress or a trusted nonprofit organization such as the League of Women Voters. But for maximum media attention and social influence, congressional or presidential sponsorship, with bipartisan oversight, would presumably be ideal. With many Americans convinced that the federal government has

grown seriously out of touch with the concerns of ordinary citizens, perhaps consensus conferences would be one way to start rebuilding trust.

Of course, we might start on a more modest level, to learn some of the ropes, before going national. Norman Vig, a Carleton College political scientist who has studied technology assessment throughout western Europe, recommends experimenting carefully in different U.S. institutional settings and at various governmental levels. For instance, the consensus conference methodology could be applied in a university setting, or at the state level on issues in science and technology policy pending before the legislature.

At least in the abstract, we Americans are fiercely proud of our democratic heritage and our technological prowess. But it is striking that we do virtually nothing to ensure that these twin sources of national pride are in harmony with one another. Consensus conferences are not a magic bullet for all that ails democracy or for ensuring that science and technology are responsive to social concerns. But they do reawaken hope that, even in a complex technological age, democratic principles and procedures can prevail and, indeed, extend into the technological domain. ■

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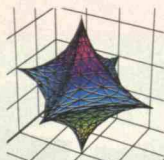
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* Wester, M., *Computer Algebra* Netherlands, Dec. 1994. Or see <ftp.math.unm.edu/pub/cas/Paper.ps>. Scores of ± 1 , 0 mean correct / incorrect and no answer.



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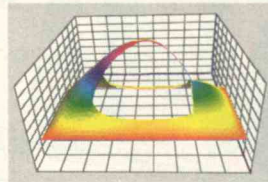
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The man who wove the first few strands in what has grown into the World Wide Web—and who oversees the organization that coordinates the Web's further development—peers into the future he's helping to create.

THE World Wide Web is giving Tim Berners-Lee a problem. He is eager to demonstrate a new feature he is working on, which will make it much easier for users of the World Wide Web to forge connections between documents, or "pages." But Berners-Lee's mouse clicks seem to fall on deaf silicon; supposed links appear not to exist, and when connections do get made the text and images flow onto the screen at less than eye-popping speed. Since everyone who has used the Web has experienced this dozens of times, it is

perversely gratifying to see Berners-Lee suffer the same frustration. Wouldn't we all love to see the inventor of the VCR get hung up on programming it to record a TV show? "Usually, this is blindingly fast," he insists, and with persistence he prevails. But the man who invented the World Wide Web is, at least for the moment, trapped in his own glorious creation.



Maestro

WITH TIM BERNERS-LEE



The Web's key feature is information connected through hypertext "links"—clicking on a word or a picture summons into the user's computer text, pictures, sounds, software, or any of a thousand and one gimmicks. So powerful is the appeal of the graphics and hyperlinks that newcomers to the online world might be forgiven for thinking that the Web is the Internet, rather than just an especially powerful and convenient way to navigate through the worldwide collection of networked computers.

Berners-Lee did not set out to invent a contemporary cultural phenomenon; rather, he says, "it was something I needed in my work." He wanted simply to solve a problem that was hindering his efforts as a consulting software engineer at CERN, the European particle-physics laboratory in Geneva. Mainly to become more efficient, he developed a system that provided easy-to-follow links between documents stored on a number of different computer systems at this international laboratory and created by different groups.

Hypertext had been proposed as early as 1945 by Vannevar Bush, and rudimentary hypertext software had been developed to interlink material among different files on individual PCs. Berners-Lee's innovation was to apply the idea of hypertext to the growing reality of networked computers. His timing was just right. In the late 1980s and early 1990s, the Internet was just starting to blossom and achieve recognition beyond a small cadre of military and research institutions that had formed its early clientele. As the number of interconnected computers grew from dozens into the tens of thousands, the Web offered an ideal way to tap into the information scattered among these machines. Berners-Lee expanded the system he had devised at CERN and made it available on the Internet in the summer of 1991.

Unlike other computer-industry figures who have become household names, he has stayed in the shadows. Rather than spin off a company to cash in on his ideas, the British-born Berners-Lee became in 1994 the first director of the World Wide Web Consortium,

a nonprofit organization with more than 100 member organizations that coordinates the development of Web software and standards. When looking for a place to locate the consortium, Berners-Lee chose MIT's Laboratory for Computer Science. "MIT has a reputation for doing the right thing on technical standards," Berners-Lee explains. Typically, he says, MIT will hold the copyright on a standard but keep it for the public good; "this isn't a place that will turn around and slap on license charges when you're five years down the road."

Berners-Lee is not, it turns out, a typical user of the World Wide Web. His use of the Web is almost exclusively related to his work on devising standards for it. Asked if he surfs the Net for pleasure, he replies that he doesn't have time for that kind of thing; Henry Ford is too busy in the garage to go out for a Sunday drive. In any case, Berners-Lee tends to dismiss complaints that the Web is too hard to search and that the gems are hopelessly submerged in gigabytes of drivel. "There's no fundamental right for people to be able to discover anything instantly," he maintains.

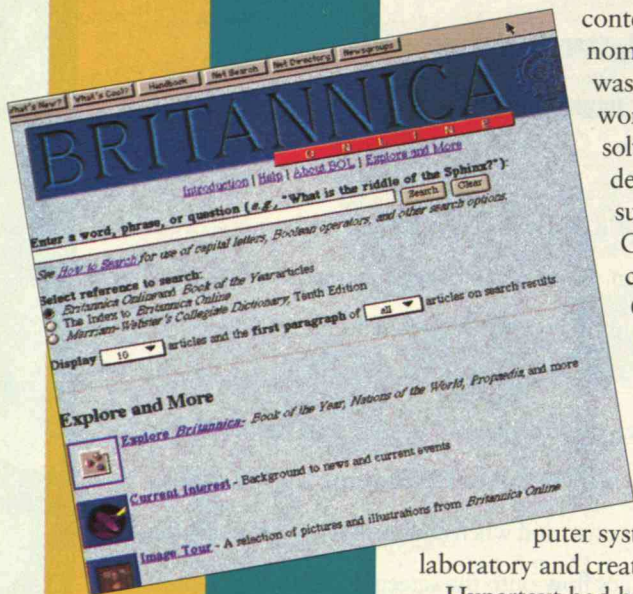
The glitch on the Web soon surrenders to Berners-Lee's careful, persistent, and knowledgeable ministrations, and the illusion of the machine taking revenge on its inventor recedes. Close call. With electronic tools now acquiescent, a confident Berners-Lee spoke with *Technology Review* senior editor Herb Brody about how he devised the Web, why its critics are off base, and how he envisions it will change and improve in the years ahead.

TR: Do you ever step back and marvel at how rapidly your idea has taken root? The World Wide Web has to have set some kind of record in the speed with which it progressed from unknown and esoteric to fashionable and then to almost commonplace.

BERNERS-LEE: Yes, the Web's growth has been exponential. For the first three years, the load on the servers was always 10 times what it was the year before. But after a few years of that kind of growth, you get used to it.

TR: Hypertext had been proposed many times before, and implemented on a small scale. Why do you think the concept caught fire with the World Wide Web?

"The better sources on the Web, such as Britannica, have involved considerable human effort, and so there will be a subscription to pay or a volunteer to thank. Or did you want quality for nothing?"



BERNERS-LEE: Earlier hypertext systems had generally been limited to pointing to documents within the same local file system. Those systems often used a central link database to keep track of all the links. The advantage of this kind of approach was that it ensured that a link would never point to someplace that didn't exist.

TR: And the disadvantage?

BERNERS-LEE: There was no way to scale up such a system to allow outsiders to easily contribute information to it.

TR: So the original concept of the Web involved a trade-off favoring universality over reliability.

BERNERS-LEE: Yes, I sacrificed that consistency requirement to allow the Web to work globally. What was really new with the Web was the idea that you could code all the information needed to find any document on the network into a short string of characters. These strings, originally called universal document identifiers, are now known as universal resource locators, or URLs. The notion that all these tagged documents from computers all over the world could share a common naming and addressing "space" was what made hypertext links so much more powerful.

TR: What was your goal in designing the World Wide Web?

BERNERS-LEE: It was something I needed in my work. CERN is composed of a variety of bright and creative people from institutes in many countries. When they work together on a project, the result can be a tangle of complexity. Coming into this organization as a software consultant, I found a tremendous need to be able to find out what was going on, particularly the interdependencies—what work was related to what. If I needed to modify some program module, for instance, what else was that change going to affect? I wrote a program called Enquire, which had a little bit of what we think of now as hypertext: at the bottom of each document would be a list of references that you could follow to immediately jump to another piece of information. I found this really useful because it was so flexible—I used it to keep track of everything I did.

TR: But this wasn't the Web as we now know it, right? Weren't you interlinking things like computer programs and their documentation?

BERNERS-LEE: Yes, mostly, but it wasn't limited to that. You could put recipes in, if you wanted, and link them back to your ingredients—so that you could follow the link from onion pies to onions, or whatever you liked.

TR: Did Enquire solve your problem?

BERNERS-LEE: Not entirely. I had details of my own work nicely organized in this web-like fashion, but what I really needed was to make links to *other* people's documents. We needed a program that was so easy to use that everybody would end up putting their data into it. That way when you wanted to collaborate with other people you could easily share data, you could point to things that they had written before, rather than having to copy them. It was also crucial to allow different people to be able to start their own webs in different places and later link them with only incremental effort.

TR: How was this an advantage over what was available to you at the time?

BERNERS-LEE: In a typical documentation system, if you wanted to make a reference from one document to another, you had to merge the two computer databases that held the information. That entailed moving all the stuff onto the same computer and arguing about who would keep it maintained. That wasn't going to work.

TR: So the Web was born not as a "world wide" system but as an internal computer network—a closed universe.

BERNERS-LEE: The network was used mainly by people working for CERN, but "closed" may not be the best word. The people at CERN did come from all over the world. And I was working before, during, and after on other projects with people from the Stanford Linear Accelerator and FermiLab in the United States and from Britain's Rutherford Lab, to name just a few.

TR: Still, it seems like a pretty big leap from a network for nuclear physicists to the cul-

For the first
three years, the
load on the first
Web servers was
always ten times
what it was the
year before. After
a few years of
that kind of expo-
nential growth,
you get used to it.

Anyone
whose Web page
carries a message
saying "Sorry,
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to enter this site"
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ment written on
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or network.

tural phenomenon that the Web has become. How did it get from there to here?

BERNERS-LEE: The first few years involved a lot of persuasion—we had to convince people to use the Web and to put information up on it. But what really made it go was the set of specifications we had developed early on.

TR: You're referring to the alphabet soup of Web standards?

BERNERS-LEE: Yes—there was hypertext markup language (HTML) for creating the documents with hypertext links, and hypertext transfer protocol (HTTP) for specifying how the network would respond when a user clicked on a link. And above it all was the system of URLs, which ensured that every item put up on the Web had a unique "address." For the Web to function and to grow, everyone had to stick to these specifications, and to agree on any changes to them.

TR: How has the Web departed from your early vision of it?

BERNERS-LEE: The original idea was that anybody would very easily be able to write documents that could be connected through hypertext links. What has surprised me is the way people have been prepared to put up with manually encoding text. HTML was never supposed to be something that you would see—it was intended to be something produced by an editor program. An analogy is with word processors. Computer users don't have to write in all kinds of codes to format their document with fonts, margins, and so on. So it staggers me that people have actually put up with having to write HTML by hand. Similarly, I had not expected people to have to work out the hypertext links by looking up and typing in those long, complex codes for addressing. URL syntax was never intended for human consumption. It was intended for a machine.

TR: But ordinary users of the Web don't need to know HTML—that's only for the people who create content.

BERNERS-LEE: Yes, but the Web needs information providers as well as readers. And the fact that creating Web pages has been difficult has directly influenced the type of information

made available on it; content is produced only by those with enough incentive to learn to write HTML.

TR: How had you envisioned it working?

BERNERS-LEE: In the prototype, you could create a link without having to write any code. You'd just browse around, find something interesting, go back to the thing you were writing, and then just make a click on a hot key, and it would make a link for you automatically. This ability is now starting to become available—in a couple of years, all the documents on the Web will probably be created without the direct use of HTML and URL syntax that is now so much a part of the Web.

No Instant Gratification

TR: The Web has a reputation in some quarters as more sizzle than steak—you hear people complain that there's no way of judging the authenticity or reliability of the information they find there. What would you do about this?

BERNERS-LEE: People will have to learn who they can trust on the Web. One way to do this is to put what I call an "Oh, yeah?" button on the browser. Say you're going into uncharted territory on the Web and you find some piece of information that is critical to the decision you're going to make, but you're not confident that the source of the information is who it is claimed to be. You should be able to click on "Oh, yeah?" and the browser program would tell the server computer to get some authentication—by comparing encrypted digital signatures, for example—that the document was in fact generated by its claimed author. The server could then present you with an argument as to why you might believe this document or why you might not.

TR: This would be particularly useful, I'd think, in verifying orders or payments for electronic commerce.

BERNERS-LEE: Yes—it would help if, for example, you find a beautiful offer on the Web for some product and you want to find out if it's for real. But this kind of verification is important for more than just buying and selling things. Every political candidate, for instance, seems to have two or three "spoof"

Web sites—they look almost, but not quite, like the real thing. When you visit the real White House Web page, for example, you can click on an icon of a cat and hear a meow. Then one day you click on a White House link from somebody's page and you click on the cat and you hear some awful noise instead—you've been spoofed. You're not really at the White House—you're at something like white-house.com instead of the real thing, which is whitehouse.gov. So you ought to be able to press "Oh, yeah?" and the browser sends out a request to cryptographically check the authenticity of the site.

TR: Another common gripe is that the Web is drowning in banal and useless material. After awhile, some people get fed up and stop bothering with it.

BERNERS-LEE: To people who complain that they have been reading junk, I suggest they think about how they got there. A link implies things about quality. A link from a quality source will generally be only to other quality documents. A link to a low-quality document reduces the effective quality of the source document. The lesson for people who create Web documents is that the links are just as important as the other content because that is how you give quality to the people who read your article. That's how paper publications establish their credibility—they get their information from credible sources. A journal on the Web, for instance, needs to have an editor who is paid to make sure that the pointers lead to good stuff. You don't go down the street, after all, picking up every piece of paper blowing in the breeze. If you find that a search engine gives you garbage, don't use it. If you don't like your local paper, don't buy it. If you find that an article refers to stupid articles, don't read it, and don't quote it yourself. Pretty soon you'll have some bookmarks on places you trust, and your reading quality will increase. You may find that the better sources have involved considerable human effort, and so there will be either advertising to read, a subscription to pay, or a volunteer to thank. Or did you want quality for nothing?

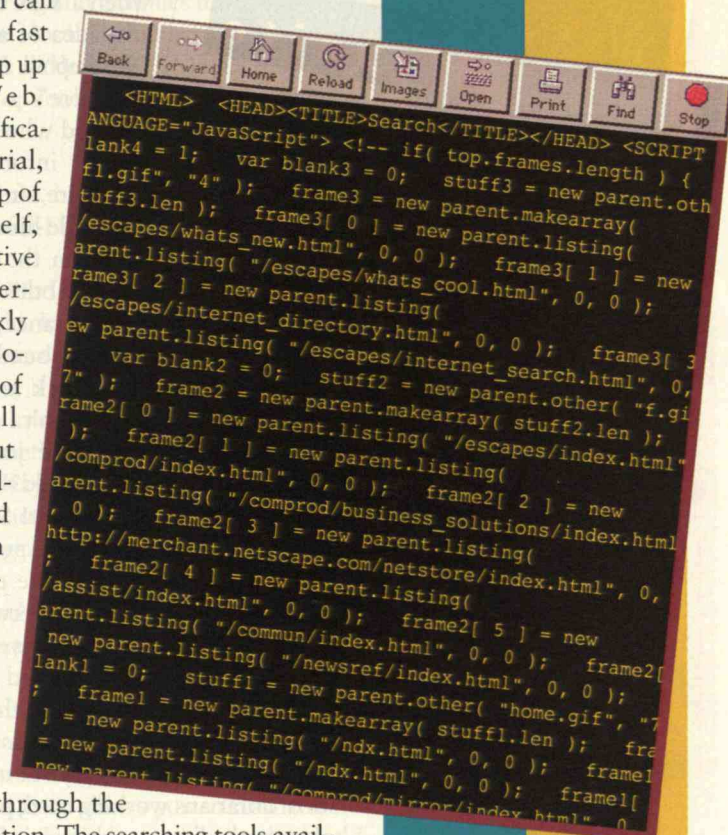
TR: While there are a number of tools to help users find information on the Web, they aren't terribly precise. Wouldn't it be better

if the creators of Web pages labeled them with keywords that could be searched for?

BERNERS-LEE: Yes, that would make searches more productive, but there are two big snags. The keywords, or the topic names, form a rather centralized rigid point in the system, which can never change fast enough to keep up with the Web. And the classification of material, like authorship of material itself, can be subjective and controversial, and quickly become obsolete. The job of classifying all human output is a never-ending one, and merges with the job of creating it.

TR: But Web users nevertheless crave better ways of searching through the sea of information. The searching tools available now give you a list of Web pages very quickly, but many of these "hits" seem to have little if any relevance to what the person is looking for.

BERNERS-LEE: People have no fundamental right to discover everything instantly. Information providers want to be found easily and will use standard ways of registering themselves and their products, and there will be tools to scan the Web so that users may quickly find them. But other providers will prefer to express themselves any way they want and thus might be more difficult to track down. They might not be cataloged, and they won't mind. So just as you have a right to scribble anything on paper and not show it to anybody, you'll also have the right to post things on the Web and not make them easily found. The Web, like paper, should be a universal medium, in which it is possible for all kinds of information to exist.



"It staggers me that people have actually put up with HTML [hypertext markup language]. It was never supposed to be something that you would see, but something produced by an editor program."

TR: People are developing high expectations, though: they want to know why, if we have all this information online, it is so hard to find what we want.

BERNERS-LEE: This question goes back to the early days, when I was really pushing this idea of a World Wide Web uphill. My response is: If there's a person in the world who is apt to have the information that you're after, go and persuade him or her to put it on the Web for you and others to find it. For instance, you can't as an academic just sit back and say, "Why can't I see a list of all the journals in my field?" Go write that list! Somebody has to put in the effort; the existence of a network doesn't give you a well-

sorted catalog of all the information on all the machines on that network for free. The existence of paper doesn't give you a library. You need a whole lot of librarians working hard, plus a whole lot of journal editors working hard, plus a whole lot of academics working hard at writing and supplying references. Together all these people produce a library full of good journals.

Looking Ahead

TR: Although begun as an academic project, the Web stands to make a few companies a lot of money. Do you see any dangers posed by this commercialization?

BERNERS-LEE: Commercialization of the Web is giving it a lot of momentum, helping it expand, and bringing it a lot of new ideas. It is true that some people feel that there is a threat that a particular company will try to take over the control of the standard protocols that govern the Web's operations.

TR: How might that happen?

BERNERS-LEE: A company could start by

releasing Web browser software and make it available free or at very low cost, to capture the vast majority of the market. Later, that company decides to introduce a feature in this product that can be taken advantage of only if the designer of the Web page deviates from accepted Web standards in some fashion. A Web user would then suddenly begin encountering pages that read, "Sorry, you need software from Company X to enter this site." Anyone who slaps a "this page is best viewed with Browser X" label on a Web page appears to be yearning for the bad old days, before the Web, when you had very little chance of reading a document written on another computer, another word processor, or another network. And once a browser vendor has established such a monopoly, it has an incentive to continue to make arbitrary changes to the de facto standard, forcing potential competitors to play an endless game of catch-up. All the other bright ideas at all the other software companies are stifled because they have to be compatible with a "standard" that changes at one company's whim.

TR: What forces might tend to prevent this?

BERNERS-LEE: If the competing companies band together and move in a different direction, then the monopoly company could lose out badly for having introduced an incompatibility. The World Wide Web Consortium helps people to agree on standards. We also sometimes write and disseminate the programming code to give people an idea of how to put these standards in place. We recently did this, for example, with style sheets, which are a nice clean way to give Web pages consistent and distinct layouts, fonts, and so on without having to insert all the formatting codes each time. Another good example is Java—a programming language used, for example, to create small applications programs, or "applets," which can be put into a Web page. When Java first came out, three companies—Sun, Microsoft, and Spyglass—introduced three different applets for inserting an animation or video file into a Web page. Since none of the companies wants to be called the incompatible one, each has to make sure it supports the other two. This is an awful lot of effort, which would be better spent improving the products. The consortium got every-

"People have no fundamental right to discover everything on the Web instantly. Just as the existence of paper doesn't give you a library, the existence of a network doesn't give you a well-sorted catalog of all the information on all the machines on that network."

body around a table, and we now have a draft of a standard that is a compatible, consistent way of doing this operation.

TR: In what ways do you think the Web is being underutilized?

BERNERS-LEE: A lot more people can browse the Web than can put up their own Web pages. The Web is therefore not being used so much the way I originally conceived it—as a communications tool that would enable small groups to work more efficiently in teams.

TR: How do you envision that kind of use?

BERNERS-LEE: Say that you conduct a meeting as a hypertext document. You start by dragging in a video version of yourself, with real-time sound. You remind those invited to come by sending them a hypertext e-mail with a pointer to the meeting. To join, they just follow the link. They can not only read this meeting/document, but they also write to it. Some join by audio and some drag their own video into the document. People introduce points by writing them into the minutes, making links to background material. At one point in the meeting three people realize they need to discuss something separately, and with a single keystroke one forks off a new meeting document that they will catch up with later. There is no rocket science here, but an integration of group editing, hypertext editing, and real-time audio-video technologies. These technologies all exist in crude forms, but must mature and be standardized before global hypertext teams can feel comfortable using them.

TR: So the Web could be used for a kind of videoconferencing?

BERNERS-LEE: Yes—participants would have video cameras connected to their computers, and they would all see on their screens a picture of the meeting. This kind of videoconferencing is possible right now, but not everyone has a fast enough Internet connection—that is, enough bandwidth—to transmit all the data needed for full-motion video. One option is to represent people who don't have enough bandwidth with flat, cutout shapes, which could change when the person is talking or indicates a desire to talk. Other people will be present as a real-time video image. All of these will be put into the virtual space so that they all

seem to be part of a room.

TR: Wouldn't this require a leap forward in graphics? Images on the Web now are pretty two-dimensional.

BERNERS-LEE: Yes, but I expect three-dimensional rendering and graphics to become common. I mean, look at that screen over there. You call that a "desktop"? Maybe that's how a real desktop looks from a camera flying at 10,000 feet.

TR: It's stylized, but it seems to work. What's the benefit of 3-D, other than razzle-dazzle?

BERNERS-LEE: It provides a better model of the real world. In the physical world, people's documents overlap each other and stack up in piles. Imagine if you could build "shelves" on your screen and you could fly through them and find something that you put somewhere. Maybe this way of presenting information will click with how people actually store and retrieve things.

TR: What other refinements in the Web are you most eager for?

BERNERS-LEE: I hope that the notion of having a separate piece of software called a "browser" will disappear. A browser is something that (a) only allows you to read and not write, and (b) is a single window on the world. Instead, your entire screen should be a window on the information world, with a small part of it representing what's on your local "desktop." Browser and operating-system interfaces will become so interlinked that they will, for all practical purposes, become one. Whether the operating system swallows the browser or the browser swallows the operating system, there will be one interface. As with the television and the home computer, the question of which will "win" is really a question about which companies will come out on top; the resultant object in any case will be both.

TR: What will using the Web be like in a few years, assuming these developments occur?

BERNERS-LEE: You won't see a browser, you will see a document. You'll follow some links and find other documents and these documents will leave a trail of documents across your desk. And then you might find that one

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People who complain about too much junk on the Web should remember that you don't go down the street picking up every piece of paper blowing in the breeze. A link from a quality source will generally be only to other quality documents.

of them takes you to a store, and in the store you find a shopping cart that you can move around and put into it things that you want to buy. And then at the end of the day you can buy what's in the cart. The code that makes this cart do what it does won't be anything you've bought, but when you first click on the cart icon that software will be automatically transferred through the Net to your computer.

TR: So software would be acquired on a need-to-use basis?

BERNERS-LEE: Yes, as you wander around the Web, your computer will become encrusted with pieces of software necessary to allow you to interact with and represent to you the things that you're reading about. If you happen to be an astronomer and you've been looking at spectra, then spectrum-analyzer software will allow you to manipulate them. If you're a biology student and you download some images of DNA molecules, then the code to send this DNA will come with a little bit of software that allows you to spin it around and break it up. And so your computer's software ability will not depend on where you've been *shopping* but just where you've been *reading*—where you've been browsing on the Web. The very idea of software will become a bit more submersed. It will be seen less as a discrete entity that you go out and buy and more as a support to the objects that are part of the information space. The software will move on and off your machine without your having to worry about it.

TR: What you're talking about sounds like a world in which far more people write software than do now.


BERNERS-LEE: Yes, but they won't think of it as creating a program. They will just be creating documents, but the software needed to view and manipulate these documents will be part of it. Tables of data will have spreadsheet software built into

them, for example, but the person writing the table certainly won't have to write a spreadsheet program. Java is a step in this direction. But an incredible amount of work needs to be done to achieve the user interface that I have rather glibly described. We also have to establish a level of trust that makes it possible for information to move from the Net onto your computer and to do work, possibly including writing files onto your hard drive. You want to make sure that it's not possible for a malicious person to be able to send you something that will look at your personal files and override them, or broadcast their contents.

TR: Are there any other items on your World Wide Web wish list?

BERNERS-LEE: I want better international access, especially in developing countries. And I'd like to see a more organized market of Web server space, so that everybody with an Internet connection could put information out cheaply. I expect that computers able to use the Web will become fairly ubiquitous, about as pervasive as televisions are now. In fact, the last computer I bought can play video—when you have a computer and good Web access, who even needs a television? I don't think everybody will want to post information on what amounts to a global bulletin board, but I certainly hope that every business has a Web page. I would also like to see deregulation of telecommunications globally so that Internet access to the home becomes cheaper. The United States is better than Europe in this regard, but even here Net access is not as cheap as it could be.

TR: Why do you think the Web has resonated so strongly with today's culture?

BERNERS-LEE: The openness of the Web is a powerful attraction. Everyone can not only read what's on the Web but contribute to it, and everybody is in a sense equal. There's a sense of boundless opportunity. 

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MITnews

FROM THE ASSOCIATION OF ALUMNI AND ALUMNAE OF MIT

JULY 1996

ROTC Stays. . .for Now

AFTER MONTHS OF GATHERING AND ANALYZING FACTS FROM INTERNAL AND EXTERNAL SOURCES AND VIEWS FROM ALL SECTORS OF THE INSTITUTE COMMUNITY—A “HERCULEAN EFFORT” THAT WAS UNIVERSALLY PRAISED—THE ROTC TASK FORCE OFFERED, AND THE FACULTY APPROVED, A SET OF RECOMMENDATIONS THAT INCLUDE A “CONSTRUCTIVE ENGAGEMENT” WITH THE DEPARTMENT OF DEFENSE TO DEVELOP A MODIFIED RESERVE-OFFICER TRAINING PROGRAM THAT IS “MORE INCLUSIVE AND IN KEEPING WITH THE VALUES AND MISSION OF MIT.”

As currently required by law, all branches of the U.S. military including ROTC are governed by a “don’t ask, don’t tell, don’t pursue” policy in regard to sexual orientation. It means that the services are not permitted to inquire about sexual orientation or launch investigations to ferret out suspected homosexuals. But homosexual conduct and even statements of same-sex preference can be grounds for discharge, or, in the case of cadets and midshipmen, for withdrawal of ROTC scholarships.

The removal of a requirement for an up-front statement of sexual preference and the prohibition on investigations

represent an improvement over the policy that prevailed prior to 1993. But today’s approach “does not address the core issue of the ban against gays in the military,” the Task Force wrote in its final report, and is in clear violation of MIT’s general anti-discrimination policy. The military ban has triggered many rounds of debate on campus, the most recent culminating with the vote at the April faculty meeting.

This latest study began last fall, when President Charles Vest delivered his charge to the ad hoc ROTC Task Force, under the leadership of Professor Stephen Graves: to gather information,

engage the MIT community in informed discussion, frame the issues for the faculty, and recommend a course of action. All complete—to the max. The Task Force distributed 3,000 copies of an interim report in January, produced a 25-page final report in March, and made a number of adjustments to its original recommendations to respond to community concerns. It created a Web home page that had received 1,400 visits by the time it was drafting its final report. It held two campus-wide forums and more than 25 meetings with individuals and groups. In all settings and circumstances, it listened.

Alumni/ae Association Executive Vice-President William Hecht, ’61, is quick to note that of some 117 letters commenting on the value of ROTC that were sent to President Charles Vest or directly to the Task Force, 80 came from alumni and alumnae. As a result of publication deadlines, the *Technology Review* article on the interim report of the Task Force was not in the hands of alumni/ae until March, observed Hecht—himself a past participant in Air Force ROTC—but once informed of the discussion on campus, graduates lost no time in expressing their views.

Among the points that the Task Force emphasized in its final report was the principle of the “citizen soldier,” which posits that a democracy is more secure if its military leadership is representative of the whole population—people who bring a range of personal and educational experiences—rather than coming only from a professional elite trained at a few military academies. Through their ROTC programs, MIT and more than 500 other schools produce the citizen soldiers who fill some 60 percent of the nation’s officer slots. Through the exten-

Contents July 1996

MIT WILL WORK FOR A MORE INCLUSIVE ROTC	1
LEMELSON-MIT PRIZE HONORS THE ROOTS OF BIOTECHNOLOGY.....	3
CARTOONIST TAKES ON SCIENCE.....	4
CLASSES.....	5
<i>The Benefactions of Elliot Wolk '57.....</i>	19
<i>Turing Award to Manuel Blum '59.....</i>	20
COURSES.....	35
<i>Architect a Wizard with Wood.....</i>	37
<i>Computer Museum Honors Forrester.....</i>	39
<i>Former Prof Dies on Bosnia Flight.....</i>	41
DECEASED LIST.....	45
PUZZLE.....	47

A Word from the Alumni/ae Association President:

Class Notes have eaten up so much of our space this month that I will be very brief. As I write this note, Commencement is approaching. The question that has been running through my mind is this: As I welcome the new graduates to the Alumni/ae Association, what am I really welcoming them to? At its narrowest, it is to a corps of bright, hard-working people who have absorbed a lot of wisdom from the faculty and from each other and have mastered a certain body of knowledge and way of thinking. At its broadest, it is to a set of people who are part of a bigger world and ready to contribute to it in many ways. Do you have a favorite definition? As always, I welcome your thoughts.—KAREN ARENSON, '70

ROTC continued

sive training and financial support offered to ROTC cadets, these schools also make considerable personal opportunity available to their students—a chance to build a career while serving the nation.

But to deliver such benefits, the Task Force went on, these schools have been forced to accommodate a policy that excludes gays. This compromise impairs the climate of honesty and integrity that should mark every educational enterprise and that is particularly crucial for young people navigating a period of self-definition during their college years.

"This Institute must be careful not to support policies that systematically encourage students to be dishonest about their sexual orientation," the Task Force wrote, adding that it is convinced that ways can be developed "to monitor and control the 'don't ask, don't tell, don't pursue' policy within ROTC units at MIT to the temporary and mutual accommodation of both MIT and DoD."

That was the Task Force's tone throughout its report, resolutely optimistic: We have a problem here; but this is MIT, surely we can solve it. But faculty were not so sure. They debated whether MIT would have more impact on the national policy by separating itself or staying involved with the military, and many doubted that the military will be willing or even able, in the light of the climate in Congress, to meet MIT's goals.

In the end, the faculty seemed to think MIT should try both strategies—staying in, and if that doesn't work, getting out—but conveyed faint hope that either would be effective. The Task Force report admitted that the most likely source of redress will be the courts, where a number of challenges are being raised to the laws and regulations that apply to homosexuals in the military. Eventually, "one or more of these challenges will reach the Supreme Court," the Task Force wrote, and "when it is appropriate to do so, MIT will file an amicus brief."

MIT faculty meetings are not typically the site of intense debate: attendance is sparse, comments are succinct, and the

number of speakers usually quite limited. Positions are hammered out in committees, and the results are presented and confirmed once a month in 10-250. However, although the heavy lifting with regard to ROTC—in terms of gathering and reconciling myriad views—also happened in committee, both of the general meetings at which ROTC was discussed were marked by an unusually full discussion and considerable feeling on the part of the speakers.

Faculty members were using these meetings not only to register their views on specific aspects of the Task Force recommendations but also to make larger comments about inclusiveness, principle, and freedom of speech. They wrestled with the value of "making a point" versus actually bringing about change. In one particularly moving statement, a faculty member placed the discriminatory ROTC program in the context of the "constant humiliation" of his own experience as a gay man on campus. He told of being deprived of the seamless life of the professional—where work and self are fully integrated—and of being expected to keep the ordinary travails and delights of his most important emotional attachments totally invisible to his colleagues.

Most speakers, including President Vest, praised the civility of the discourse at MIT and the efforts of the Task Force. (Vest otherwise limited his comments on the topic because he ultimately would be responsible for following up on the recommendations of faculty.) One faculty member did chide his fellows for a "self-congratulatory sense." But given the level of discussion in some forums outside MIT, it was hard not to be impressed at the restraint, thoughtfulness, absolute agreement on the goal, and aching candor that marked these meetings.

At least one faculty member raised in public an issue that was frequently raised informally: concern about the addendum to a federal budget bill that enjoins the secretary of defense to review and possibly revoke any other DoD relationships—such as research funding—with schools that curtail their commitments to

Biotech Inventors Take Lemelson-MIT Prize

ROTC. The Task Force report acknowledged that this threat cannot be treated lightly: DoD funded 17 percent of research on campus and 85 percent of the research at Lincoln Laboratory in 1994. But particularly in light of the many unknowns in implementing that action of Congress, the Task Force said that it made its recommendations entirely independently of any such consideration.

Among those faculty-approved recommendations: MIT will negotiate with DoD to open on-campus ROTC programs, such as leadership training, to all qualified students, without discrimination, including those whose homosexuality would bar them from being commissioned as officers. The Institute will also undertake to "reinsure" any cadet who loses his or her ROTC scholarship because of sexual orientation.

(MIT will provide a standard need-based financial aid package, plus an optional supplement, based on a commitment to two years of public service, that will bring support up to the level of the ROTC scholarship. When asked how much this provision might cost MIT, Task Force Chair Stephen Graves said there was no way to predict, but he noted that no MIT student had lost ROTC support since 1990.)

The recommendations also call on the Institute to name two committees: a continuation of the Oversight Committee, which will monitor the ROTC curriculum, ensure that MIT's ROTC commanders share the goal of nondiscrimination, monitor any inquiry into the homosexual conduct of a ROTC cadet or midshipman, and make an annual report to the faculty; and an advocacy group that will both work for change in the national policy that prohibits homosexuals from serving in the military and promote respect and tolerance on campus.

If substantial progress is not made toward implementing the Task Force goals within two years, the faculty will consider further action.

The voice vote on the recommendations was almost unanimous (one "no" vote and three abstentions), with an estimated 80 faculty present. □

—SUSAN LEWIS

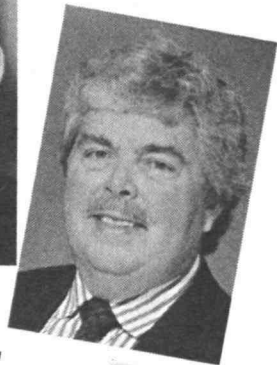
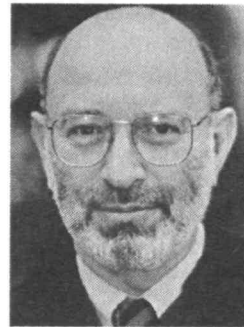
It was over a midnight snack at a delicatessen in Hawaii during 1972 that Stanley Cohen and Herbert Boyer began a collaboration that would result in the advent of the biotechnology industry—and in the pair's sharing the \$500,000 Lemelson-MIT Prize for 1996.

Both Cohen and Boyer were in Hawaii attending a scientific conference. And although they had been working on the mainland only 40 miles apart—Cohen was then an associate professor of medicine at Stanford University, and Boyer was a biochemist at the University of California at San Francisco—it was not until their meeting in Hawaii that they learned of their complementary research.

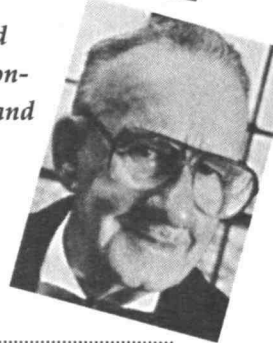
Cohen was investigating plasmids—small, circular pieces of DNA that are found in many bacteria and that carry genes that enable bacteria to develop resistance to particular antibiotics. "In my research on antibiotic resistance in bacteria," he said, "there was a need to find a way to take plasmids apart and then to propagate their genes in new combinations in living cells in order to study how the genes worked." Ultimately, Cohen was able to introduce plasmid DNA into bacteria.

Boyer, meanwhile, was trying to understand how a cell selects the correct DNA sequence from an entire DNA strand when it needs to manufacture a specific protein. Working with "restriction enzymes," which slice DNA into strands, he found that the resulting DNA segments left after cutting have two "sticky" ends. If a similar piece of DNA is added, it joins to the cut DNA, forming a new molecule. This process, the two scientists theorized, could be used to cut Cohen's plasmid DNA into specific segments and then combine the segments to make new plasmids.

Back in California, they began a frenetic collaboration that continued for three months. "It was an extremely exciting time," Cohen remembers. "We worked literally day and night. Things were too exciting for us to get very much



Top down:
Stanley Cohen and Herbert Boyer shared the \$500,000 Lemelson-MIT Prize for 1996, and Wilson Greatbatch was honored with this year's Lemelson Lifetime Achievement award.



sleep. It was a continual high."

Together they were able to splice a piece of foreign DNA into a plasmid, which would then insert the DNA into a bacterium. When the bacterial cell multiplied, it also reproduced the DNA. Thus, DNA cloning and the field of biotechnology were born, and seven years later, human insulin became the first commercial product of this new process. Since then, biotechnology has created billions of dollars in revenues, tens of thousands of jobs, and a myriad of existing and potential health benefits.

Despite this success, funding for the kind of basic research that led to genetic engineering seems to be drying up, according to several speakers at the press conference at the New York Academy of Sciences in April to announce the Lemelson-MIT Prize winners.

"I suspect that in 1996 it would not be possible to obtain support for studies as novel as those that Herb and I and our collaborators carried out in 1973," said Cohen, now a professor of genetics and medicine at Stanford.

"It is a somewhat sad commentary on the funding of science today," he added,

"that peer review committees probably would conclude that such work had too small a likelihood of success to merit support." Similar concerns were voiced by Lester Thurow, Lemelson Professor of Management and Economics at the Sloan School of Management and chair of the Lemelson-MIT Prize selection board.

Speaking at the press conference, Thurow noted that a lot of basic research had been funded by the Department of Defense, which "was willing to have a longer time horizon than the typical civilian funding agencies." Furthermore, DoD "could finance a lot of research that failed and nobody said, 'that's horrible, close it down.' On the civilian side of our government, if it doesn't work, the reaction tends to be the opposite," Thurow said. Meanwhile, he continued, increased international competition has caused private-sector laboratories to go out of business, since "the minute you become a competitive industry, you've got to look at the short run" and pare costs to a minimum.

But major funding is not always required for important innovations to occur. Witness the case of Wilson Greatbatch, the inventor of the implantable pacemaker, who was also honored by the Lemelson-MIT Prize Program as this year's recipient of its Lifetime Achievement Award. In 1958, Greatbatch, who holds some 150 patents, was building an oscillator in a workshop behind his home in Clarence, N.Y., when he accidentally grabbed a one-million-ohm resistor instead of a ten-thousand-ohm device. When he turned the oscillator on, "the thing went boop," said Greatbatch. "A little later, it went boop again. So I tore it apart, looked at it, and said, 'That's a pacemaker!'"

As with Cohen and Boyer, the serendipity that led to Greatbatch's invention was born of a highly inquisitive mind that was predisposed to seeing what others might overlook. And it is to nurture such minds that Jerome Lemelson—himself the holder of over 500 patents covering elements of technologies such as the camcorder, the VCR, and facsimile transmission—established the Lemelson-MIT Prize Program in 1993. The purpose of the prize is "to inspire the youth of this country to take the risks to invent, innovate, and

be entrepreneurs," explained Glen Urban, dean of the Sloan School, while speaking in New York.

Greatbatch, Boyer, and Cohen each received a lead crystal award that incorporates edge-lit holography (invented at MIT's Media Laboratory) at this second annual presentation of the Lemelson-MIT Prize. Following the press conference in New York, the winners were honored at a ceremony held at the Smithsonian Institution's National Museum of American History in Washington and moderated by MIT President Charles Vest.

Capturing the spirit of the Lemelson-MIT Prize, Greatbatch exhorted young people to seek careers in science and then follow their goals to conclusion. "Don't fear failure, and don't crave success," he said. "The true reward is not in the results, it is in the doing."

Boyer, too, spoke of the joy of innovation. "The basic characteristics of human nature include the desires to further knowledge and improve the condition of mankind," he said. "It's a component of man's nature to want to help people, and when you can do it, it's really very nice." □ —VICTOR D. CHASE

A Cartoonist Takes on Science

During Independent Activities Period this year, MIT students learned to shape near-meaningless squiggles into silly faces in class under the guidance of a creator of books that can be used as college texts. The venue was a three-evening seminar on cartooning techniques, where cartoonist Larry Gonick loosened up his students by having them draw lines and circles as they listened to the music of James Brown and Chuck Berry. As their right brains took over and their creations slowly acquired human shapes and began to project human emotions, Gonick demonstrated how simple strokes of a pencil could illustrate anger or happiness, shock or boredom.

When it was listed in the IAP Guide, more than one hundred people—fresh-

men to faculty, graduate students to staff—tried to sign up for one of the eight places in the class. And although the class sounded like a lark, Gonick has impressive credentials for his task: Describing himself as an "overeducated cartoonist," he holds bachelor's and master's degrees in math from Harvard and was a 1994–95 recipient of a one-year Knight Science Journalism Fellowship at MIT. He is known for conceiving a new way of learning the sciences through books that combine hilarious illustrations with essential information. His oeuvre includes *The Cartoon Guide to Genetics*, *The Cartoon Guide to the Computer*, *The Cartoon Guide to Physics*, *The Cartoon Guide to Statistics*, and a 13-volume series entitled *The Cartoon History of the Universe*.

Out in April was his latest effort, the *Cartoon Guide to the Environment*. Alice Outwater, SM '87 (TPP), wrote the text, an assignment that not every science writer could handle: when Outwater finished her 800-page manuscript, she was told it would have to be pared down to 80 pages, since the book uses cartoons to illustrate many points. Each of Gonick's

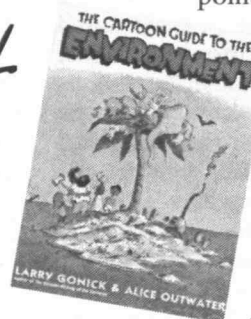
books undergoes this extreme distillation process.

Discarding the nonessential information and presenting much of what's left in cartoons not only speeds up the comprehension process, it allows non-sci-

entists (and non-historians) to comfortably explore subjects they might otherwise find intimidating, and it encourages students to read and re-read.

Gonick's works are popular not only with casual book buyers. The *Cartoon Guide to Genetics* was the sole textbook last year in the introductory molecular biology class at Harvard, and MIT's Sallie Chisholm, the McAfee Professor of Civil and Environmental Engineering, is considering adopting Gonick's *Cartoon Guide to the Environment* for one of her classes next year. Chisholm saw the book in draft form, and says that "the benefit of such a book is that it gives the students the big picture in one interesting sitting. It provides a structure for learning the details." □

—MELISSA CHAPMAN



ClassNotes

19

Florence Langille writes with the sad news that her husband, Class Secretary Wilfred O. (Bill) Langille, passed away March 30 at Somerset Medical Center in Somerville, N.J. After a hospitalization of several weeks for pneumonia,

from which he was convalescing, Bill's condition began to deteriorate and he developed complications. April 7th would have been his 100th birthday. An obituary will appear in the August/September column of these Notes. We extend our heartfelt sympathies to Florence and to Bill's classmates.—Class Notes Editor, *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

20

We received word from Charles D. Carlton that he is healthy, "but no special activities." He is living in a retirement community.

Please send news for this column to: Class Notes Editor, *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

21

Please send news for this column to: Carole A. (Cac) Clarke, president and secretary, 608 Union Ln., Brielle, NJ 08730-1423; tel: (908) 528-8881

22

75th Reunion

Please send news for this column to: Class Notes Editor, *Technology Review*,

MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

23

I have just learned about the death of our first class vice-president, David Joy, whose death occurred more than a year ago. David received his degree in electrochemical engineering. He started his career with the National Carbon Co. of Cleveland, Ohio. He worked with the motion picture and TV groups. In 1961 he retired, and with his wife, Muriel, spent five months traveling around the world by air. They spent most of their time in India, Nepal, Ceylong, Hong Kong, and Japan.

David was vice-president of our class for many years. Harry Kalker now becomes first VP. We no longer have a second or third. Does anyone wish to apply?—Royal Sterling, secretary and president, Apt. D201, 2350 Indian Creek Blvd. W., Vero Beach, FL 32966-5103

24

I received a charming letter from George Knight from Hants, Great Britain. He states that for almost 20 years he and Edith have spent half their time in New Hampshire and half in England. Two years ago they sold their house over here and now have only the "thatched cottage" in England. They still plan to visit this year as they did last year.

George also passed along an article from the British *Daily Telegraph* referring to a current exhibition of Frederick Leighton's paintings at the Tate Gallery in London. He wondered if Luis Ferre could be the "appreciative owner in far off Puerto Rico" of the painting *Flaming June* mentioned in this news story. He remembers Luis Ferre saying that his collection included pictures he liked rather than famous works.

I was notified by the Alumni/ae Association that Henry John MacMillan passed away March 20, 1995. He is survived by his wife, Bernice MacMillan. Henry was retired from Albany International Corp. He died at his home in Santa Fe, N.M.—Co-secretaries: Colonel I. Henry Stern, 2840 S. Ocean, #514, Palm Beach, FL 33480; Katty Hereford, 237 Hacienda Carmel, Carmel, CA 93923

25

The passing of two classmates must be reported. Israel Goldberg died on January 13, 1995. He had lived in the Boston area all his life. He worked for the Stone and

Webster Engineering Co. for many years and at the time of his retirement was assistant chief design engineer. After retirement he was a consulting design engineer for several years.

Frank W. Warburton died in Westboro, Mass., on December 13, 1995. For many years he worked for the New England Electric Systems in Worcester, Mass., where he was head of Central Lab.—F. Leroy "Doc" Foster, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

26

Thomas D. Green writes that he cannot make the reunion. He is living in a retirement community, the McAuley in West Hartford. He's still in good health and still driving

his car. . . . Henry A. Sargent also cannot make the reunion, but he has joined the MIT club in D.C. and has so enjoyed several of their programs.

Alberto Ortenblad, of Rio de Janeiro, died in August 1994. His son, Carlos, says his father was very fond of MIT and used to read with attention and great pleasure all the mail forwarded to him. "I am quite sure that if he were alive he'd make his best efforts to attend

the reunion," says Carlos. . . . Alden F. Butler, of Springfield, Mass., died in a Harwich rest home. After retiring in 1970, he worked as a consultant for American Bosch in Breda, Holland, and Colombari, Italy. He was also employed by Stanley Works in New Britain, Conn. He was a former president and treasurer for the Worthington Golf Club. He leaves his wife, the former Florence Quinn; a son, a daughter, six grandchildren, and three great-grandchildren. . . . Allen B. Bassett of West Oneonta, N.Y., died February 1, 1996. . . . Milton B. Morgan of Newton, Pa., died on January 18, 1996. We send condolences to the wives and families of these classmates.

Please send news for this column to: Class Notes Editor, *Technology Review* MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

27

70th Reunion

Please send news for this column to: Joseph C. Burley, secretary, 1 Harbourside Dr.,

#3501, Delray Beach, FL 33483; Lawrence B. Grew, assistant secretary, 21 Yowago Ave., Branford, CT 06405

28

We have reports of the death of several more of our valued classmates for this issue of the *Review* with little other news of note. I hope you are mindful of and resting up for our

70th Reunion in two more years, for which we should have responses concerning attendance from as many classmates as possible so that they may be a part of the spring (April and May/June) 1998 issues of Class Notes.

Lawrence Fowler Armstrong died on December 8, 1995, in Three Rivers, Mich. Army was chairman of the board of Armstrong International as his last contribution to his profession.

Henry Joseph Gunning died on June 21, 1995, in Pebble Beach, Calif. Hank was retired at the time of his death.

Walter Henry Francis Mattlage died on October 3, 1995, in Boca Raton, Fla. Matt was a retired executive VP of the Dupont Co. in Wilmington, Del., and was VP of Remington Arms, Inc., during WWII.

Norman D. Nault died on March 1, 1996, in Sarasota, Fla. Norman had a distinguished career in architecture, specializing in educational and institutional buildings throughout New England.

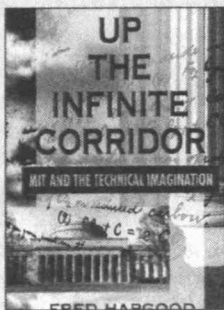
Chih-Kung Jen died on December 3, 1995, in Malden, Mass., though his home was in Silver Spring, Md. Professor Jen was a theoretical and experimental physicist at Johns Hopkins University for many years. Born in a mud hut in a northern province of China in 1906,

Up the Infinite Corridor MIT and the Technical Imagination

by Fred Hapgood

This lively, eminently readable account of MIT's engineering research will stir up memories while bringing readers inside some of the current projects happening around the Infinite Corridor. Delving into MIT's rich, sometimes bizarre history, *Up the Infinite Corridor* explores the folkways of undergraduate life, as well as the

unique sense of humor that emerges from the pressures and insecurities of the place where everyone's intellectual accelerator is wired to the floor.



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he was the only member of his immediate family to learn to read. He started in our class at MIT and went on to many other degrees in the U.S. He returned to China and took part in the "academic long march" of students and faculty to southern China to establish a "refugee university" that operated during the Japanese occupation, after which he was honored by the Chinese government and returned to the U.S. to continue his scientific work.

We regret the loss of our friends and offer our condolences to their families.—**Ernest H. Knight**, secretary and president, 168 Ai Plummer Rd., Raymond, ME 04071

29

Unfortunately, the only news we have to report this issue is three deaths: **Laurence D. Luey**, of Charlotte, N.C., on August 10, 1995; **William H. Jones**, of Sun City, Ariz., on

November 11, 1995; and **E. Neal Wells** of Pinellas Park, Fla., on December 28, 1995. When we receive more information, we will pass it on.

Please send news for this column to: Class Notes Editor, *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

30

Some months ago **Bill Perret** sent me an extensive account of his travels in Europe in the year after he graduated, during the course of which he was accompanied at various times

by **Alfred Waidelich** and **Howard Robinson**. I have been hoarding this saga pending the arrival of a month in which there is little current news to report. This month is it.

It seems that in July 1930 Bill and Al met at a German language school in Berlin where they "learned some Deutsch and much about Berlin's night life." They then spent two months traveling by foot and by train through Germany and Switzerland. This portion of their travels included "hiking through the Hartz mountains and down the Rhine to Cologne, and through the Black Forest to the small town of Besenfeld where Al's granddad got his start. Then by train to Switzerland and La Chaux de Fonds where my (Bill's) granddad was born." After passing through Bern, Interlaken, the Bernese Alps, and Zurich, they reached Munich in time for the Oktoberfest. At that point it was time to go back to school.

Al returned to Zurich to study structural design at a Hochschule. Bill returned to Berlin where he had an opportunity to study wave mechanics under Schroedinger, quantum theory under Fritz London, and advanced integral equations under von Mises. These courses ended in late February, and it was time to travel again. Their junket in the spring of '31 took them to Prague, Vienna, and Salzburg and then into Italy, where they visited Florence, Rome, and Capri at Easter, thence via Lakes Como and Lugano back to Zurich. At that point they separated, with Al going to Darmstadt and Bill to Munich.

In Munich, Bill met **Howard Robinson** who, like Bill, graduated in Course VIII. They both had rooms at the Studenten Heim and took several courses at the university. Munich had a lot of good opera and beautiful mountainous

country that Bill and Howard sampled on several weekends. At that time the Nazis were getting to be a nuisance, closing down the university for a week because a professor made some reference to the Treaty of Versailles that they didn't like. In August, Bill and Al met in Strassbourg and, after a week in Paris, embarked at Boulogne for the trip home.

A few weeks ago, **Lester Steffens** telephoned from Norwalk, Conn., to say that he and a friend were planning to make a brief visit to Williamsburg and that he would like to touch base with both me and Wilbur Mount, who lives here at the Landing and who was a long-time associate of Les at Socony-Mobil. By a coincidence, at the time of Les's visit the Mounts were entertaining John Happel, '29, and his wife. Thus the Mounts, the Happs, Les and his friend, and the Listers were able to have dinner together one evening. Les and I spent some time reminiscing about Course X-B, the undergraduate Chemical Engineering Practice School option that we both took and that no longer exists. It appears that of the seven classmates who spent January and February 1930 at the Bangor, Maine, station, Les and I are the only survivors.—**Gordon K. Lister**, secretary, 5707 Williamsburg Landing Dr., Williamsburg, VA 23185

31

We have two deaths to report: **Harold J. Davis**, of Chelmsford, Mass., on October 24, 1995; and **George Moy**, of Camarillo, Calif., on September 12, 1995.

George quietly passed away after a series of illnesses. He is survived by his wife of 60 years, Bertha; a son and daughter-in-law. Our sympathies go out to the families of both these classmates.

Please send news for this column to: Class Notes Editor, *Technology Review*, MIT W59-200, 77 Mass. Ave., Cambridge, MA 02139

32

65th Reunion

Ed McLaughlin, our class agent for the past nine years, considered it wise to resign

because of his declining energy level. Audrey Saracco of the Alumni/ae Association expresses well how we all feel. I quote from her letter to Ed and his wife.

"I am honored to be a messenger, sent to you by the class officers of 1932, bearing a heartfelt, sincere expression of their gratitude. You find enclosed herein a plaque which commemorates your laudable service to the Class of 1932 and to the Institute as class agent over the past nine years. I know **John Brown**, class president, along with the other officers were eager to show you their appreciation in some way that went beyond words. . . . Thank you, Mr. and Mrs. McLaughlin for your effort and your spirit. We all send you our very best wishes for tranquil years to come. We hope you will keep in touch!"

Arthur Marshall says that it is with deep regret that he is resigning as class treasurer. He had spinal surgery on February 6 and says he'll be "out of the loop" for about six months. We all wish Arthur a good recovery and more productive years.

James Gould Ritchey wrote us a most inter-

esting letter of which I am pleased to excerpt the following: "I may not have been an average student in that I graduated in 1932, but started in the class of 1929. The extra time was spent in coal mines, the forest service, and in manufacturing plants in the Boston area.

"Your discussion about leadership interested me. I see some of the things that help develop leadership ability as being important in many professions and occupations (helpfulness, planning, written and verbal communications, and generally seeking to develop cooperation and goodwill).

"Mrs. Ritchey and I made a trip to Israel and Jordan with a professor and study group from the Presbyterian Seminary here in Louisville. Some observations I want to offer: solar panels were in general use; there are stones and rocks everywhere; most dwellings and other buildings use these stones as a basic building material. We went to see the Chagall windows in a Hadassah hospital in En Karem, a suburb of Jerusalem. I found as much of interest in this hospital as the windows. It is a large, modern, state-of-the-art hospital performing all of the most advanced procedures and research projects.

"In the 19 years since retirement, I took work at the Presbyterian Seminary and became involved in pastoral care at hospitals, my church, hospice, and for the last 15 years at the University of Louisville Hospital. This probably explains my resonating to what I learned of Hadassah in Jerusalem." Thanks, Jim, for your letter. We hope to hear from you again soon.

Rose and Tom Weston write us about their wonderful trip through the Panama Canal and the surrounding islands. Tom tells of a wild ride along the Panamanian highway from Panama City to Colon with a police escort who used sirens and flashing lights, waving traffic to one side. Rose sat in the front seat and took "great pictures" with the camcorder. Perhaps we can see them at the class reunion, Tom.

We are sorry to report that Charles Taylor died suddenly from a stroke on November 3, 1995. Charles worked for the U.S. Treasury with the IRS. He also worked many years as chief inspector for the Division of Alcohol Tobacco and Firearms in the New England states. Charlie was active in our class affairs, serving on reunion committees. John Brown represented our class by attending his funeral.

Next issue will contain news about our 65th Reunion. All for now.—Melvin Castleman, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907-1643; tel: (508) 531-0053

33

This year the U.S. Department of Education will receive 10 million requests for aid in advancing college education. The two Class of 1933 funds combined have assisted nine

students in the years 1994-95 and 1995-96. The four recipients from the Class of 1933 fund for 1994-95 were: Oded I. Asherie of Larchmont, N.Y.; Claudia D. Rodriguez of Paseo del Pedregal, Mexico; Linda Chien of Irving, Calif.; and Jinzy J. Zhu of San Jose, Calif. The latter two are currently receiving funding for 1995-96 as well as newcomers Brett D. Rosen of Boston and Timocin H. Per-vane of Plymouth, Mass. From the Class of

1933 Robert M. Kimball Fund there were three students who received support for this year 1995-96. This is the first year that recipients of this fund are being reported. The three are: Rishi Shrivastava of Marion, Ind.; Robert J. Meagher of Detroit, Mich.; and Jennifer S. Merritt of Birmingham, Ala. These last three are all juniors. As of last year at reunion time, the combined market value of both funds was \$731,879. Should any of you want specifics on these students, I'll see that you are informed if you just ask! I can testify as to the wisdom of these choices. They are very diversified in their fields of study, yet without exception all wish to achieve at higher levels.

A daughter of William A. Kilbourn (Course II) by the name of Leslie Nesky wrote me a charming letter saying that her Dad is in good health and always cheerful.

Although he can no longer see well enough to write for himself, he loved hearing from us. He may be reached at 58 Austin Rd., Sudbury, MA 01776, c/o Leslie Nesky. Bill was a plant superintendent with Rivett Lathe & Grinder Co., Waltham, Mass., until his retirement. As president of Lawrence Academy's alumni/ae association and joiner in many men's clubs, Bill would have much to reminisce about.

Winslow H. Hartford, PhD

(Course V) did not merely write me, he hand-lettered every bit of three pages in caps and lower case. Since I am similarly afflicted I was thrilled to read the letter over and over. Win was prompted to write by reading of the death of Robert B. Kinraide in the Feb/Mar Deceased List but had not read anything in the Class Notes as to his passing. Win most enthusiastically speaks of a remarkable group of 16 dorm-men and brown-baggers, all brought together under the leadership of Douglas Sloan when they were in Troop 1, Newtonville, Boy Scouts of America, in the years 1926 to 1932. He sent me a photocopy of seven of this tight-knit group after climbing Mt. Washington, which included Joe Keithley, '37, Ed Swainson, '37, Dick Jarrell, '35, Robert Kennigott, '34, Al Ziegler, '31, and of course our own Robert Kinraide.

They were all outdoorsmen and crack riflemen, skiing in New Hampshire every possible weekend. Best of all remembrances, Win says he and Bob Kinraide used to ride to MIT in style in a 1930 black-and-silver Studebaker President Eight roadster. One cold snap they had to build a small fire under the oil pan to get the starter to spin the massive 100 hp 8-in-line with its crankcase of SAE 40 oil (no multi-grade oil then, he says). Winslow Hartford and wife were in the process of moving when I called but he did promise a photo of the Mt. Washington climbers. The new address is 5800 Old Providence Rd., Apt. 3310, Charlotte, NC 28226.

At this point I wish to express my thanks to

ClassNotes

the many classmates who have written about my Coutances Xmas card. One such classmate is Converse W. Sweetser (Course XVI). Saying he has been inactive in alumni affairs, the

same is not true of his career with Grumman Aircraft from graduation until he retired 20 years ago. His specialties with Grumman included stress and mechanical design. He represented Grumman on an Airworthiness Requirements Committee of the Aircraft Industries Association. In Huntington, N.Y., he must be well known for his musical talent, which included playing organ and singing with the Township Concert Association for 40 years and with church choirs for 60 years. Converse enclosed a photo of himself dressed for the '95 spring concert of (what else) the Huntington Men's Chorus. Oh, how we would love to have him sing with us at reunions or at the drop of a hat!

I. Harry Summer scrolled some ideas as to keeping a class-book of all surviving classmates—that's the way I interpret his idea in a letter to me from Palm Springs, Calif. Harry, you

missed the coldest winter in Illinois history but, with a bit of help, your hot idea will eventually come about for the 65th Reunion.—Berj Tashjian, secretary, 1245 Briarwood Ln., Northbrook, IL 60062-4556; tel: (847) 272-8683

34

While in California, Jim Eder and your secretary had lunch on the porch of the Rancho Bernardo Inn. Jim Sweeney was unable to make it. Allan Mowatt, '35, was there but

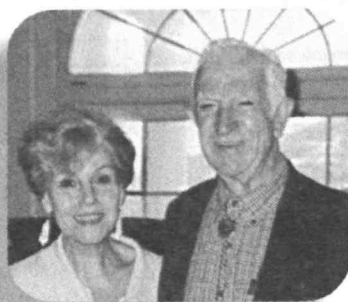
Hamilton Dow, '35, couldn't make it. Jim Eder has also served as class secretary, so we had three former or active secretaries there. It was pleasant in the California sunshine, at the edge of the beautiful Rancho Bernardo Inn course. Jim Eder looks great. He has moved into

San Diego near Balboa Park, across the street from his son and his family. It was agreed that we would repeat the luncheon in the first week of January 1997. A recent sailing opportunity arose and a friend of mine in Coronado took Jim and I sailing in his 46-foot sloop that is a delight to behold and a thrill to sail.



Jim Eder & Carl Wilson

Our backlog of December mail that we did not receive until late January contained several letters and greetings from VP Ed Asch. Ed and Annette spent June and July on the good ship



Annette & Ed Asch

Maasdam. Boarded in London, they toured all the capitals of the Scandinavian countries plus St. Petersburg, Russia, and Germany. Ed enjoyed a tour of the German countryside on a narrow gauge steam train to the Baltic Sea spa at Warenmunde. August was spent at the shore in Galveston, where Ed celebrated his birthday. Home again, and then off to Colorado, Pike's Peak via the cog railway, the Red Rocks, and the Air Force Academy. A stop in Estes Park at the Stanley Hotel, named for two brothers who developed the Stanley Steamer, the fastest car on the road 85 years ago.

A message from Page "Bud" Golsan. His health is only fair and his wife Isabella has had a few health problems. They volunteer at the Salem, Ore., Memorial Hospital. He reads constantly and his favorites are murder mysteries; favorite authors are Rex Stout and Agatha Christie. A recent trip took them to Bainbridge Island, Wash., to see their granddaughter and two great grandsons. They both walk about two miles daily. He sees John Whittington, '24, every day.

Timothy Coleman writes from Pelham Manor, N.Y., to tell us that he is in good health, and his wife is fine. They have two children and two grandchildren, and they have recently celebrated his 86th birthday. They have recently visited their daughter in Washington, D.C., and their son in Potsdam, N.Y. Bud does volunteer work for the Grand Juror's Association and the MIT Club of N.Y. He collects Canadian and Australian stamps. His favorite author is Edgar Allen Poe. He exercises regularly. . . . Bert Summers sends us a snapshot taken in Honolulu in November 1995, and he looks great. He writes: "I have been happily retired from the construction business for the past two years. Edie, my wonderful wife, and I are in reasonably good health. We were married on April 26, 1941. We always attend the San Francisco Opera performances in the fall of the year. I am still a management trustee of the Cement Masons Trust Funds of Northern California and have been since they were organized in 1953. I am also enjoying our home, lovely large garden, and our lovable beagle, Peebles." . . . Our man from NATO, Paul Voyatzis, writes from Wellesley, Mass. Paul retired from the U.S.



Bert Summers in Hawaii

Army as a colonel. He tells us that both he and his wife are fine. They have one child and two grandchildren. He writes: "We are fortunate to have our daughter living in Wellesley within walking distance. Granddaughter, Zoe, is a first year student at Colby. Our grandson, Paul, a freshman at Wellesley High School, enjoys breakfast with the grandparents." Paul enjoys reading and current events is his favorite subject. He exercises regularly by taking long walks. Last spring, they spent 10 days in London during the VE-day celebration. They took in some theater and met with friends from their five-year stay in London in the 1970s. When asked if he volunteers, Paul answered: "I volunteer advice to our daughter, son-in-law, and grandchildren." He tells us further: "If I were younger, I would probably be in Bosnia with the NATO headquarters charged with the coordination of NATO forces, AFSOUTH (Allied Forces, Southern Europe), which was my last overseas assignment before retiring from the U.S. Army."

Charles Burwen, from Delray, Fla., just celebrated his 84th birthday. He writes: "Other than bladder cancer (1980) my health is great. My wife, to whom I have been married for 61 years, is also in reasonable health. In 1978 I retired from Boston and moved to Florida, a state I have come to love. I am never bored. I have a son, a daughter, and three grandchildren. I am interested in government, economics, music, golf, bridge, and computers. Also, being MIT-trained, I seem to have a talent for fixing things and do so for several of my friends and neighbors, many of whom I am sad to relate are widows. My exercise consists mainly of walking nine holes of golf four or five times a week. I still take a cut at the ball like I did when I was younger but for some reason the ball refuses to travel as far as it used to. There are very few of my classmates around. Most of them are deceased, and I cannot remember when I saw the last one. Because I was in Course IV, architecture, a five-year bachelor course, I grew up with the Class of '33, which would make my group a year older, on average, than those in '34 and at my age every year counts."

Sam Prince writes, "We have been wintering in Florida for many years and have discovered a plan for a very interesting experience driving home. We select a state east of the Mississippi River and explore it in depth. We start by reading up on the early history of that particular state in *Inside USA* by John Gunther, 1954. With that basic knowledge, we find out more from the visitor's state welcome station. What follows is an unexpected delight. For example, we found North Carolina teeming with fascinating historical, cultural, and educational goodies, buildings, col-

leges, cultural stories of the Civil War, and great characters at the turn of the century." When Sam's brother passed away last year, Sam and Edna inherited his home in Laguna Hills, Calif. They find it a delightful place to live and have made some "most pleasant friendships." They winter there and return to Cape Cod the rest of the year. Sam and Edna have three children and four grandchildren. His hobbies are gardening, the opera, and reading—Michener and *Time* magazine (cover-to-cover).



Sam Prince

Richard Shaw and his wife are both in good health. They have two children and two grandchildren. They enjoy hiking and bird watching. He says, "As a youth in my sixties, I took my wife rafting through the Grand Canyon and hiking it from rim to rim. Now we often go to the nearby Shawangunks where we can take leisurely hikes and sleep in a comfortable hotel." Richard reads occasionally; history is his favorite subject. He volunteers as a cashier in the hospital tea room, exercises regularly, and has not seen any classmates since Ernie Norris and Russ Buehl passed away.



Charles Burwen

Five students, three seniors and two sophomores, currently receive funding from the Class of 1934 Karl T. Compton Scholarship Fund. Alonzo Castro, from Pacoima, Calif., is a senior majoring in electrical engineering and computer science. He is an active member in La Union Chicana por Aztlan, a campus activity for Hispanic students. As a member, he attends conferences and helps organize community service events. The group has an academic support program wherein the members tutor each other.

Alonzo's summer work has included an engineering internship at Hewlett-Packard in Santa Rosa, Calif. . . . Howard Cheng, a senior also majoring in electrical engineering and computer science, comes from Seattle, Wash. In the Lab for Electromagnetic and Electronic Systems he did a UROP (Undergraduate Research Opportunities Program) in the transformer monitoring group. Over the summer he was an engineering assistant at International Power Devices in Allston, Mass. He is also VP of his fraternity, Phi Kappa Theta. . . . Brian Schuler of Maysville, Ky., will graduate this spring with a major in aeronautics and astronautics. In keeping with his academic direction, Brian participated in a UROP, designing and building a hybrid rocket. His summer job was in engineering at NASA/Lewis in Cleveland, Ohio. Brian has also been a unified engineering teaching assistant. . . . Jennifer Hammock, '98, from Kirkland, Quebec, Canada, has declared her major in chemistry. With a career objective to do chemistry/biology field research in the interest of wildlife conservation, Jennifer was active in a UROP in the environmental protection field. She is an assistant stewardship officer of her living group, a tutor of ESL (English as a second language).

students, a volunteer for the campus "Safe-walk" program (which provides escorts for students walking from place-to-place on campus late at night), and an enthusiast in skating and square dancing! . . . Xiaozhen Zhang of Houston, Tex., a sophomore in electrical engineering and computer science, is maintaining an outstanding academic record. The summer found Xiaozhen interning at Exxon in Houston. She is the secretary of the executive board of the MIT Gospel Choir, and active in Project Contact, an outreach effort to contact prospective MIT students. They are grateful to us for the help we have been able to give them through our contributions.

Warren Kunz sends along this note with his annual contribution: "Big news is that Iona and I are still enjoying life, although Iona had a very scary brain hemorrhage in March that dominated most of the year. She is now fine and enjoying her watercolor painting and much else."

Margo Wesley sends news of the tragic death of her father, **Charles Wesley**, in a boating accident. Charles died on September 25, 1995. He worked as an electronics engineer until his retirement from Perkin Elmer in Danbury, Conn. Following his retirement he worked part-time for several years at his own repair business and at Yale University. He was active in many organizations and was also an avid bicyclist and rower. He had not rowed since college, but began again in his 70s. He is survived by his wife of 60 years, Alice, three children, two sisters, a brother, and four grandchildren. The family takes "great consolation in that our father was unusually active and healthy throughout his life, and died doing what he loved best: boating in the Atlantic. In fact, he was out alone trying out a new navigational device (he loved gadgets) when his boat capsized."

Your secretary closes with best wishes for the continued good health and well-being of you and your families. Keep busy and well, and write!—**Carl H. Wilson**, secretary, 50 Point Pleasant Rd., Webster, MA 01453; tel: (508) 943-6066

35

At press time for the May/June issue, we learned of the deaths of Hal Bemis, class agent, and Allan Mowatt, your longtime class secretary.

Walter Stockmayer and **Thonet Dauphine** will be acting secretaries and are writing obituaries to appear in August/September for these two beloved class members. Following is Mr. Mowatt's last column, which was already in type when we learned of his death.—ed.

Paul G. Heckart, a Course VI man, is the first of the nonwriters with an interesting letter to "break the ice." He and his wife, Janet, had a good time at the reunion, all the events, talking to a few old friends, and meeting other classmates. They walked the halls that he used to "scurry through as an undergraduate." They met Professor David Pritchard, who is doing important work in quantum mechanics. They did not see any of those Paul studied under but noted that Gordon S. Brown, now professor emeritus, was honored in Tucson.

After the reunion, Paul and Janet visited friends in Maine and made a short trip

through Canada. Paul says, "We were having supper in a pub in Quebec at the precise moment that the New Jersey Devils won the Stanley Cup. The Canadians think that the Stanley Cup belongs in Canada as the Americas Cup belongs in the U.S." Paul and Janet have been going to Vermont every year and have seen **Walter "Stocky" Stockmayer** a few times. Janet's niece lives in Wheaton, Ill. When they visit there, they also visit Dorothy and **Lars Sjodahl**. They are in touch through Christmas letters with Alice and **Otto Zwanzig** who live in Denver.

John S. Holley writes from Chula Vista, "Hi guys. I'm still kicking; how's by you? I'm in good spirits. No, I don't drink *that* much. I don't have much flesh left, so I carry around a seat cushion for when I have to sit on those stone benches at the Balboa Naval Hospital. They are doing a superior job taking care of my innards. I'm busy too. I've prepared a paper "Busting the Big Bang," but nobody's paid any attention so far. All I have to do is prove one point." . . . **Charles D. Hanley** sends the following message: "Will write secretary."—**Allan Q. Mowatt**

Please send news for this column to **Walter Stockmayer**, acting secretary, Department of Chemistry, Dartmouth College, Hanover, NH 03755-3564; tel: (603) 646-2503; fax: (603) 646-3946; e-mail: <walter.stockmayer@dartmouth.edu>; or **Thonet C. Dauphine**, president, 57 Alcott St., Acton, MA 01720-5540; tel: (508) 263-3494

36

Writing for a March deadline of the July issue, I cannot describe the weather of our 60th Reunion (remember the gutter-overflowing downpour during Pops at the 50th?), but

some features can be anticipated. On hand for individual or klatch videotape viewing: (1) **Bob Newman's** fast-moving travelogues; (2) a 1995 PBS discussion of **Bob Woodward** by Harvard and Cornell peers and old film clips on his Nobel Prize-winning achievement—first synthesis of vital drugs occurring only in nature, e.g., the quinine of cinchona bark, which earned him the kudo "Einstein of Chemistry"; (3) for our many sailors, three of the 1992 America's Cup races, when Bill Koch's ('62) America³ held off the Italian challenger, provided by **Bill Beckwith**, whose granddaughter worked on Koch's staff; and (4) some homemade tapes of classmates and the 55th Reunion. Survivors of the Class Crew planned to meet at the Pierce Boathouse for presentation of **Ken Winsor's** bronze sculpture of an MIT oarswoman, wearing togs fashioned from pictures of Linda Muri, '85, a two-time international gold medal winner and pinch-hitting coxswain of our 50th crew. Watch for actual reporting of the 60th in the October issue.

Continuing from the May/June issue, **Darby Merrill** won a BOIT Prize writing a play for Professor Bill Greene in 1934, but was suspended for marks in December of senior year. Lobby **Lobdell**, '17, asked Darby: "Did you just not like certain courses?" So he did penance for 13 months, but got practical experience working for National Aniline Co. in its dye lab. Then he changed courses from VIII to IX-A (general science), got his diploma in 1939, but retained his 1936 identity. In 1954, he earned a master's

ClassNotes

degree in physics at B.U. Darby's success with Air Force reconnaissance photography was the culmination of exposure to the genius of Doc Edgerton, '27, Professor A.C. Hardy's expertise in spectro-photography, and his own connection with Eastman Kodak between WWII and Korea. He spent 59 years in color research, beginning with Hardy's hand-built recording spectrophotometer at National Aniline and ending with 33 years at MITRE. He credits his career to wife Helen and their family, the Institute, and to pure research programs he was privileged to be part of.

Still another return from the mail canvass: **Julius "Bus" Schliemann** (Course XVI) enlarged on his brief 50th biography—"Many moves in my career. Life not too exciting, but satisfying." From Bridgeport to Dallas (Chance Vought), back to Boston (Anderson Nichols and Nortronics), and then Baltimore-Annapolis (Waltham and Security Consultants), he moved from design engineer to VP and a CEO. He and wife Ruth summer in Brewster and have traveled in Europe, Morocco, and Australia. . . . The canvass was of classmates who had not been heard from, other than the 50th Reunion, for 10 years or more. But it would be great to hear again from those who have appeared in these Notes infrequently. Please send a note now. Time gets shorter.

Cheers for the lives of **E. MacDonald Nyhen** and **John P. Allen**! "Mac" was in Course VI-A but transferred to Harvard in sophomore year and got an SB in physics and an MBA. Nevertheless, he cherished his MIT roots as director of the electronic industries division of U.S. Department of Commerce, attending Tech reunions and responding with biographies for the 25th and 50th. On my "tour of three cities" in 1993, he organized the Washington luncheon, with attendance by some classmates living beyond the immediate area. In WWII with the Army Air Force, he developed tactical communications for three invasions and won the Bronze Star. His wife, Patricia, died in 1964, and Mac's death, November 28, 1994, went unnoticed until **Kathleen Schott Cummins** forwarded a *Washington Post* obituary, which made no mention of the Institute. . . . Please, all readers, remind your kin to notify the Alumni/ae Association.

A note from **John Allen's** daughter, Nancy Perrow, tells of his death September 27, 1994, "after a brief battle with cancer." As a colonel in the Army Reserve he was buried in Arlington Cemetery with full honors and a military band, which she described as a very moving experience. John, a lifelong model railroader, was architect for Chesapeake and Ohio Railroad buildings and towers in the 1950s, and about 1960 he joined Ballou and Justice in Richmond. His projects included hospitals, city halls, and the reconstruction of Jefferson's rotunda at University of Virginia with air conditioning, etc., yet true to its original appearance. In retirement he completed 311 paintings, some winning awards, and a number in private and corporate collections.

A note from **Audrey Saracco**, program coordinator in the Alumni/ae Association, conveyed her "sympathy for the loss of your assis-

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M. Walbaum, SM '88

tant, Mr. Patterson. From your words I gather he put his talents to work for his friends and classmates, a generous gift indeed." Amen!—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501; tel: (505) 988-2745

37 60th Reunion

Now that we are back to summer weather, all the horror stories of last winter are coming out. Your co-secretaries have one. In late December, we agreed we should get together. We decided to meet, with our wives, at Brookhaven, Len's Life Care Community, and picked the date. We chose January 10, not expecting that the worst blizzard in years would hit the Northeast on January 8. After this washout, we picked January 25—no better. We skipped to February 16; it snowed like mad. We moved "safely" to March 5, primary day. You guessed it—another snowstorm. We gave up and are using the telephone. So much for **Bob Thorson** and **Len Seder**. On a warm day this summer, we shall try again. Be assured no important class business will suffer.

Class treasurer **Ralph Webster** also had problems last winter, including a bout with pneumonia. I hope he is okay now. . . . A welcome letter from **Harry Corman**, now a Vermonter, says that he spent the winter in Florida again and was blessed with a new grandson on his 80th. He still plays a little tennis, but assumes he will soon have to give it up in favor of golf. A sadder decision was giving up flying. For 52 years, he has piloted his own plane, cheating the airlines out of many a fare. (I well remember a beautiful summer day when he flew his wife, my wife, and me from Boston to Nantucket for a great weekend. What a way to go!) He now describes himself in picturesque terms as being too old for that sort of thing. He reports that **Sid Mank** and his wife, Dot, are now in Charlottesville, Va., and that **Lincoln Herzeca** is in Coral Gables. He is looking forward to seeing all of his classmates at our 70th Reunion.

Norman B. Robbins writes from Fort Worth, Tex., that he, too, is hoping to make the reunion. His wife, Christine, passed away not long after they celebrated their 51st wedding anniversary. Norm says he is in good health and playing a lot of golf. He is also assisting his grandson's middle school to compete in the U.S. First competition for robotic machines. Norm says it is similar to the MIT program out of Manchester, N.H. He has a daughter who is president of the State Street Bank and Trust Co. in Hartford, Conn., and a son who is manager of community relations in Lockheed-Martin Tactical Aircraft Systems. This is the same company from which Norm retired as VP of the Fort Worth Division of General Dynamics.

In our last notes, we recounted the difficulties that our Class President **Phil Peters** has suffered as a result of an unfortunate skiing accident. After two operations, he has made much progress, but then had to undergo a third surgery for a cataract. We all hope this will be the last of it.

Reunion bells are ringing. The Committee has had a first meeting and you will be hearing details very soon, if not already.

From **Gil Mott** we learn of the death of **Max Jacobs**, in February. Max was a member of the family that founded and operated Detecto Scales. In addition to his wife, he left three children and one grandchild. Gil says that until about a year ago, Max, **Cliff Lytle**, and he used to get together for lunch several times a year. "He was great company and hardly seemed to change since MIT days. He was teaching computer science at a community college in New York. We will miss him greatly." Our condolences to Max's family.

With regret, we report the death of **J. Robert Ferguson** of Sewickley, Pa. He received the Bronze Beaver Award of the MIT Alumni Association in 1980 and was honorary member of the Corporate Development Committee in 1982. He leaves his wife, Dorothy, to whom we extend our sympathies. We have no further details, but hope to receive them.—Co-secretaries: **Leonard A. Seder**, 1010 Waltham St. 342-B, Lexington, MA 02173; **Robert H. Thorson**, 66 Swan Rd., Winchester, MA 01890

38

Ed Hadley has forwarded the first 20 return cards that arrived in response to **Fred Kolb's** January 1996 letter which gave you up-to-date news on the June 7 mini-

reunion, and plans for our 60th Reunion underway by **Norm Bedford** and **Sol Kaufman**. The first 20 returns all contained comments. Of those who expect to attend the mini-reunion, **Carol** and **Al Wilson** were skiing at Bretton Woods in New Hampshire and one night at dinner they met **Phyl** and **Don Severance** who were also skiing there. . . . **Harry O. Saunders** from Seattle still travels monthly to California or Illinois where he participates in farm land administration growing corn or soybeans. He expects to see us in June.

Harold Strauss advises that **Henrie** became seriously ill December 26 and their plans do not include anything except her recovery; however, they remain optimistic and their attendance estimate remains "maybe!" . . . **R. Gretchen Birge** says, "I'd like to be there but I fell in February and broke two bones in my left wrist and cracked my right patella (knee cap)." . . . **John B. Garvin** is prevented from participating due to a brain-stem stroke in 1994. . . . Mrs. **Jack T. Wilbur** writes that **Jack Wilbur** has been in the Lutheran Home in Worcester for two years with Parkinson's and dementia. . . . **Jack Chapin** laments that the loggers who harvested 300 trees from his property left more than they took, so that he's too busy cleaning up to travel.

Barney Oldfield's trip from Florida will depend on the flow of royalties from *King of the Seven Dwarves* published in April by the IEEE Computer Society Press. . . . **Hope** and **Phil Sellers** expect to be in Europe in early June. . . . **Robert D. Solomon** will be celebrating 60 years as a member of the American Chemical Society next year, and has a "must" in his early June schedule this year—a grandson's graduation. . . . **Donald R.E. Barnaby** writes from El Granada, Calif., that they attended an elderhostel in the Berkshires last October and spent the month in Randolph and on the Cape. . . . **Arch H. Copeland** is still enjoying a great retirement in Arizona with his wife, Jo-Ann. Besides playing the piano and golfing, he's doing tax aide

work for the 18th year and is treasurer for a very successful chorale.

Sally and H. Erich Neitsch are looking forward to the 60th Reunion. They travel a lot and are still sailing their 30-foot sailboat on Long Island Sound. . . . **Harold W. Butler** writes, "We are hoping to join you and other classmates for the 60th." . . . **Lew Allen** has moved to Hilton Head, S.C., and **Albert M. Clogston** has a new address in Santa Fe, N.Mex. . . . **Leon Baral** writes that he is not well and has moved to a new address in Baltimore. . . . **Betty and Dave Wright** attended the funeral of Bob Ferguson, '37, in Sewickley, Pa.

Two of the returns told of the deaths of our classmates. **Paul Tillson** died September 23, 1995; and the card to **Charles M. Wheeler** was returned marked "Deceased." We are following up on these leads.

Audrey Saracco, Coordinator of Class Programs of the Alumni/ae Association, tells us that the amount of money in the Class of 1938 Scholarship Fund continues to rise each year and the number of scholars this year has been increased from 9 to 10. Five students have been renewed, while the other five are new to the scholarship. In addition, regarding the Class of 1938 Beta Theta Pi award for 1995-96, Wesley Williams of Apopka, Fla., is the sole recipient. We will have more details about the recipients available during our mini-reunion in June.—**Paul R. Des Jardins**, secretary, 6251 Old Dominion Dr., Apt. 310, McLean, VA 22101-4807; tel: (703) 534-4813; **Frederick J. Kolb, Jr.**, president, 211 Oakridge Dr., Rochester, NY 14617-2511; tel: (716) 342-3093

39

In *U.S. News and World Report* (March 18, 1996), MIT is ranked No. 1 of 50 top U.S. graduate schools for engineering and Sloan School No. 2 for business. During

the last 135 years on planet Earth, MIT leaders and alumni/ae established by their acts that MIT is a preferred place to become tooled for life. Alumni/ae are grateful to MIT's professors, scientists, officers, and employees. May they all draw satisfaction from our respect and support.

Ted Wroblewski and **Martha** are retired in Danvers, Mass. Ted plays tennis three times per week. They participate in the Danvers YMCA, Rotary Club, and their church. Ted consults on magnetic and lighting problems. Their son teaches in Saratoga (N.Y.) High School where he established a weather-science lab. Its seismograph registered an earthquake epicenter about 2,500 miles away in San Francisco, and that event was newsworthy in Saratoga. Students of the lab were acclaimed and they were invited to present a program on TV at the N.Y. state capitol in Albany. Ted and Martha, we join you in being proud of your son, his students, and what they are doing.

Don Timbie taught at Phillips Andover Academy. During WWII, he served on a U.S. carrier in the Pacific. With his wife, Barbara, he lives in New Jersey where he obtains patents. One of his latest involves sending signals at superspeed, by light instead of electricity. Don reports the death of his longtime friend and classmate, **George Blake**, Course VI-A. George commanded an artillery unit during WWII on D-Day beachhead. In his civilian

career with Westinghouse Corp., he was responsible for worldwide marketing of industrial computers, instrumentation, and related control systems. He pioneered industrial computer systems and acquisitions and established new plants and subsidiaries in Europe. He died in Pittsburgh about mid 1995.

Charles Freyfogle is retired near the Hudson River about 35 miles north of New York. After graduation, he served in WWII with the 8th Air Force in its 91st Bomb Group. His bird's-eye view of Europe was obtained with striking audio and visual accompaniment. After WWII, he engaged in manufacturing and insurance, and now he gardens in Stony Point, N.Y. . . . **Arthur Vogely** retired in Yorktown, Va. During career years, his several businesses prospered. He consults still for Projection Displays, a Seattle Corporation owned by his son. Arthur expects to stop over in Seattle this summer when his tour group travels to the Northwest and Alaska. . . . **Burk Kleinhofner** and **Connie** retired in Long Beach, Calif. Burk worked for Rockwell International on instrumentation and missile controls and the Apollo program. His honors and awards include the Naval Ordnance Award for Exceptional Service and the Certificate of Appreciation in Work under the Office of Scientific Research and Development. He wrote 15 technical papers and served as guest lecturer at University of California. From MIT he received the Morgan Distinguished Service Award.

Burk writes: "**Gail Swann**, the last of my roommates, went to the beyond November 25, 1995, in Dallas, Tex. . . . **Sears Williams** and **Jo** moved to a retirement community in St. Louis, Mo. . . . **Charlie MacArthur** and **Fran** moved to a retirement community in St. Louis, Mo. . . . **Charlie MacArthur** and **Fran** moved to a retirement community in California, Md. . . . **E. Miles Brown** and **Shirley** reside in Riverton, N.J. They visited children in Alabama and traveled with friends to Venezuela.

"**Connie** and I visit friends in Phoenix and San Francisco. We vacationed in Cabo San Lucas in Jaba, Calif., and enjoyed its bill fishing. I would ask '39er radio hams to contact me, WGLZN, on the *Queen Mary* (Long Beach, Calif.) W6RO. The Long Beach Amateur Radio Club has a ham station on the ship. All bands including PACKET RADIO. You can leave a message on PACKET. Got a neat QSL. When you come to this area, bring your ham ticket and operate the equipment on the *Queen*."

Bud Croshere's career at Douglas Aircraft included aircraft design and engineering, airborne vehicles, advanced space technology, and aerospace systems. One of Bud's hobbies includes building model ships, plank on frame. Some models are 3 feet long. They are built to scale and the rigging is authentic. These days Bud enjoys a daily swim and watching grandchildren, one of whom tops his grandfather in height and who stars on his college basketball team. Bud's thesis partner was **Orville Dunn**. Orv now lives about three miles from Bud. These partners met often for lunch over the years. On such occasions, it has been said that the truth sometimes got used loosely.

Orville R. Dunn devoted his career to Douglas Aircraft where, after a merger with McDonnell Aircraft, he became director of Aerodynamics and was active in the design of DC-8, DC-9, and DC-10. For some years, Orv and his wife, Pat, were involved in model railroading. One-fifth of their home was used for this purpose,

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and Pat, an artist, decorated the walls with scenes to fit their model railroad. Both enjoy playing the organ. In September 1995, they moved to a smaller house and they gave their whole model railroad system to the Garden Grove Model Railroad Group, who plan to buy a 4,000-square-foot building for Orv and Pat's system. Orv also consults with government, the airlines, and the aircraft industry.

Al Thackara and Cynny toured historic sites in Portugal, Spain, Italy, Greece, and the Atlantic and Mediterranean coasts abutting. They enjoyed their 12-day voyage from Lisbon to Rome on the *Wind Spirit*, a four-masted sailing vessel with a diesel auxiliary. Al's descriptions reminded Hilda and me of our European travels. On July 3, 1945, Hilda and I were married in Commercy, France, by its mayor, who conducted the ceremony in the City Hall entirely in French. Hilda did not understand French. So, at the time she didn't know what troth she was plighting. Then, 27



Al & Cynny Thackara in Sicily

years later, after completing a year for Amoco in India, we flew to Rome. There, courageously, we bought, from a complete stranger, for cash up front, a used 850 Fiat Special with blunt front, queer rear, and four on the floor. In it, we revisited the Carleton at Cannes where we had honeymooned, then drove around Europe for three months until we boarded *The France* and cruised from Le Havre to New York. Al and Cynny: when you started your 1995 tour, did you ever dream your stories would stimulate others to say: "Thanks for the Memories?"

The Thackaras expect to visit Dave Lindberg and Ellen in Sacramento, Calif., this summer.

Pete Bernays reports that Marie is making a good recovery with the knee she damaged chasing a frisbee. As governor of Kiwanis Clubs in Ohio, Pete administers only 14 clubs, not 40 as I reported previously. . . . Pete reports the death of Mark N. Curgan, Mark, Course V, died January 26, 1996. He served in the Chemical Warfare Service during WWII and retired from C.H. Patrick Co., where he had been research director, then technical director. He lived in Greenville, S.C., for 20 years and was buried with military honors in the Military Cemetery in Florence, S.C. He and Lenore were regular attendants at '39 reunions.

We are saddened by report of the death in

mid 1995 of Ben L. Krause, of Jaffrey, N.H. He died unexpectedly while swimming. We have no details.—Harold R. Seykota, secretary, 2853 Claremont Dr., Tacoma, WA 98407-2332

40

D.J. and Charles Edwards recently returned from an

MIT Alumni/ae Travel Program in Rotorua, New Zealand. (This is the third alum trip they have taken.) Geysers and a bubbling thermal pool were visible from their hotel room, and they enjoyed lectures and side trips. Charlie describes the area around Mt. Tarawera: "Walking on the volcanic rock was like walking on ball bearings." Following this tour, Charlie and D.J. spent two weeks in Australia. D.J., winner of a Betty Crocker contest, will have her portrait digitally morphed with 74 others to create a new Betty Crocker image. . . . Walter Helmreich writes that he is still active in Boy Scouts, and was recently awarded the Silver Beaver. He and Margaret celebrated their 50th wedding anniversary over Thanksgiving. The Edwards were present for the occasion, as they had stopped there on the first leg of their New Zealand trip. . . . A note from Marshall McCuen says that he has now moved into a large retirement community in Indianapolis and is enjoying it. He likes the food, the people, and the apartment. His problem is that he is confined to a wheelchair and cannot walk.

Joseph Jefferds, Jr., sent a note to say that William Merrill of Camarillo, Calif., passed away on March 11, 1996. Joe had spoken to Bill last winter, following Bill's stroke, and they enjoyed talking of old times. . . . William E. Crater, Jr., of Easton, Pa., died on October 16, 1995, leaving no survivors, but making a significant unrestricted bequest to MIT in his will. For many years, he was an electrical engineer for the former Western Electric Co., Allentown, Pa. He served as an Army Air Corps captain in the weather service during World War II.

James H. Moore writes of his involvement in the communications project originated by Class President Bruce Duffett. Jim heard from Edward Hellier that, following his retirement in 1983, he built a home in the North Carolina mountains. Then, in order to enrich his life in the mountain area, he obtained a degree in botany from Mars Hill College. Ed and Jim had both worked for the Metals Division of National Research Corp. Jim also learned that Jack Schaum retired as publisher and editor of *Modern Castings Magazine* in 1982. Jack spends the winter months at Longboat Key, Fla., and does a lot of foreign traveling, including an Elderhostel for three weeks in Thailand. He is active on several volunteer boards, and finds that the computer "adds



Walking on volcanic "ball bearings" in N.Z. (see Charles Edwards, '40)

spice to retirement."

With his class dues, Ralph Millet sent a note to Class Treasurer Richard Babish, saying that he had been busy closing up his export business. He and his wife, Gunlog, went to Scandinavia with their 14-year-old grandson, and Ralph is gradually settling into retirement. . . . Alan Thewlis proudly wrote to Dick Babish that his grandson has applied for admission to MIT for the fall of 1996, to study architecture.

Clement Burnap told Dick that he is still director of business development and furnishes expert support of claims personnel and attorneys in technical situations. At age 79, he is an avid golfer who succeeded in achieving high rank in seven tournaments last summer. . . . Eleanor Norris suffered from neck snap as a result of a car accident, but is now improving.

Another of Bruce Duffett's communicators is Robert Gould. Bob sent his annual Christmas letter, in which he mentions that he had visits from D.J. and Charles Edwards, and Marg and Walter Helmreich prior to the 55th Reunion last June. Bob is handicapped, so it has eliminated most of his and Marion's traveling, but they are happy to be in their home on Mirror Lake, N.H. Last fall, they were visited by close friend Norman Scott and his family.

David Fleming retired 10 years ago after spending his career with the Industrial Gases Division of Union Carbide. He was in charge of the Development Lab concerned with new processes and equipment to expand the market for gases, and later he was involved in business management. He regrets that he was unable to attend the 55th Reunion, but he wanted to be close to his son, who was undergoing surgery, from which he has now recovered nicely and has returned to work.

Please let me hear from you in order to provide interesting tidbits for future columns. Write or call Richard E. Gladstone, secretary, 250 Hammond Pond Pkwy., 1205 S, Chestnut Hill, MA 02167-1528; tel: (617) 969-5161

41

This news, written in March, will be stale for the attendees at our recent 55th at MIT and Martha's Vineyard, June 6-11. For the rest, who should be the first to sign up for our 60th (at MIT and at this time unknown exotic locale), here is the news:

Ray Harper writes, "After many years in hiding, I decided to attend the 55th Reunion—thus this letter. My career included a wide variety of activities that ended seven years ago when I gave my financial consulting business to one of our five children." (One son chose Harvard over MIT!—secretary's comment) "Over the years I've been delighted to see Margery and Mitch Marcus a number of times. Last year I visited my roomie, Lloyd

Perper, who lives on a mountain top near Tucson, where he and his lovely wife have enough books to fill a local library." From Ray's similar note to **Will Mott**, it sounds as if he and his wife were in the Orient during February 1996. From the *Santa Rosa Press Democrat* (Calif.), under a three-column picture of Ray headlined, "Playing Guru to Upstart Banks," are details of his career. Ray assisted over 100 community banks within the Northern California triangle of San Francisco, San Jose, and Sacramento, owning stock in every bank he helped start. Obviously he has a bias towards the business that has provided his livelihood: "I wouldn't help any bank that I wouldn't own stock in," said Harper, who purposefully avoided consulting for the troubled savings and loans industry in the early 1980s. In 1989, when the article was written, Ray was handing over his Santa Rosa-based Raymond Harper & Associates, to his son, Courtland, who lives in Oakland. He continued to help communities, where it took people "a half to three quarters of an hour to get to a bank," or where some other clear public need for a bank existed. Banks for specialized economic groups such as Silicon Valley with its high-technology business, or Summit Bank on "Pill Hill" in Oakland, which serves the specific needs of doctors, are other examples of Harper-coached banks. "It's a rifle vs. a shotgun," he says. "Harper's 25 years in the business has been a great time of expansion in banking with the number of California banks doubling to some 400. Many of those banks he helped start are gone because of the common occurrence in banking: small banks grow into big banks." The article concludes, "So as Harper heads into retirement (1989), he is holding his shares close to his vest. 'I put them into a safe deposit box and wait until the bank sells!'"

John Murdock <swim@endlesspools.com>, one of the few to supply news by e-mail, writes: "Janet and I are in good health. Our three children and eight grandchildren are all doing well. Life is, and has been, good! I still play the xylophone (usually Vivaldi) with computer accompaniment. I write essays on my Macintosh such as my 'Sixteen Simplistic Solutions' to our country's problems. I 'invent' things: in 1990, it was an exercise machine for swimmers; in 1992, it was a seafloor nuclear power plant. **Joe Gavin** and **Will Mott** have helped me on this, but neither has really endorsed the idea. In 1995, it was a new type of hearing aid based on a very directional microphone system. **Fred Haddock** and **Bill Hargens** have both been helpful, but Fred feels that I am running counter to a basic physical principle. My next project will be an additive for skimmed milk to make it more opaque. Skim milk now looks like gray dishwater and doesn't cover the 'All Bran'! Janet offers this definition of a generalist: 'One who doesn't do anything really well.'"

The neat thing about e-mail is that the secretary can copy your thoughts directly into the notes without retyping! Sorry we didn't have all of this classmate input in time for our May/June notes. It would have been good background for our Martha's Vineyard bull sessions, but on second thought, it might have discouraged the writers from presenting it in person! . . . Please send news for this column to: **Charles H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD 20817-4839; tel: (301) 229-4459; e-mail: <olspaceman@aol.com>

42 55th Reunion

Donn Barbour writes that he's been in touch with **John Lacey** and sees **Fred Gander**, **John Crandell**, **Bill Strong**, and **Hank Henderson** several times a year. . . . **Charlie Lawrence** is semi-retired but still does some civil engineering consulting from his home in Santa Barbara. . . . **George Toumanoff** has moved to a retirement home in River Mead, N.H., and has a farm nearby where he spends summers. Invites all classmates to call and stop in if they are in that area.

Bob Blake, '41, visited with **Jack Stewart** at his parents' apartment in New York and heard the story of their escape from Yugoslavia in 1941. They left all their possessions and got out of the country by horsecart. They got to the Adriatic, were rescued by a British cruiser, and eventually got home to the States. . . . **Jon Noyes**, senior VP of Principal Financial Securities, Inc., says he's getting older and slower but had just returned from 10 days of skiing in Colorado. Kay is still working in real estate, and they have eight grandchildren.

Tentative schedule for our June 1997 reunion includes Tech Night at the Pops, Commencement, Technology Day Reception, and then Challenge Games. **Betty Speas** met **Betsy** and **Ken Leghorn** on a Panama Canal cruise. She's still living in Maryland, but hopes to move to Amherst, Mass., to be near her children and grandchildren.

Robert A. Frost died at his home in South Dartmouth, Mass., last September. He had lived in South America, Vermont, and Wellesley previously. He was a member of the New Bedford Yacht Club and was a past president of the Dartmouth Natural Resources Trust.—**Ken Rosett**, secretary, 281 Martling Ave., Tarrytown, NY 10591

43

Faced with little but obituaries for this month, I placed a call to **Chris Matthew** and learned that he is almost fully recovered from the aneurysm that nearly did him in last year. A complicating blood clot has been dealt with, so Chris is about to resume the Maui-California-Cambridge circuit. One small impediment is the fractured elbow suffered by Marge in a fall. At the Ides of March she was wearing a sling and undergoing therapy. . . . **Chris** and **Jim Malloch** have been trying to put together another Albuquerque-style mini-reunion on the West Coast. So far, they have only good intentions to show for it.

Also in March, **Jim McDonough** was recovering from a mild heart attack. His treatment was angioplasty and a metal fitting. Convalescence included starting to organize the committee for the 55th Reunion. Can you believe it's only two years away?

I have received additional information about **Raymond Richards**, whose death was reported in the May/June Class Notes. A native of Cleveland, Ohio, Raymond was elected to Tau Beta Pi at MIT, then served during WWII as a Marine Corps captain in the China Theater. His 40-year career at Koehler Manufacturing Co. in Marlboro, Mass., included filling the positions of executive VP and treasurer. He was a member of the MIT

ClassNotes

Club of Boston and for 32 years served as treasurer of the Lutheran Church of the Good Shepherd in North Quincy.

I must also report the death last October 31 of **Herbert M. Johnson** (Course VI-A) in S. Lancaster, Ontario. Herb was president of C-Tech Ltd., located in Cornwall, Ont. He is survived by his wife, Lydia, to whom we offer our sympathies.

A short note from **Hamilton Herman** (Course XVI) says that he is spending substantial time helping his town of New Canaan, Conn., with the multimillion-dollar expansion of three grammar schools. In addition, he has lots of outdoor activities—fishing, hiking, skiing, river-floating—but occasionally goes inside to compose the family history on his new computer. He also leaps tall buildings at a single bound.

While it's heartening to have the good news about **Chris** and **Jim**, I'd like more to report than the casualty list. To quote Scripture, "How beautiful upon the mountain are the feet of him who bringeth good tidings." So let the good tidings flow in.—**Bob Rorschach**, secretary, 4727 S. Lewis Pl., Tulsa, OK 74105-5138

44

We are writing this column with great sadness, for we are reporting the deaths of four comrades-at-arms.

Robert A. Plachta, Course XV, was in the CAC ROTC.

He died on July 28, 1995, and is survived by his widow, Anne, a Wellesley alumna. Bob retired many years ago and had been enjoying recreational activities at his home in La Jolla, Calif.

Stanley Gertz, Course XIV, died on October 18, 1995. He is survived by his widow, Charlotte. There are no details.

James E. St. Germain, Course XVI, died on January 14, 1996, after a protracted illness. He is survived by his wife, Loretta, daughters Anne Marie Dixon and Irene Carter, sons James and John, seven grandchildren, three sisters, and two brothers. This sad news was sent to us by his brother Peter, '48. Jim graduated in February 1944 and immediately entered the Navy where he served over two years as an aircraft engineering maintenance officer. He and Loretta were married in June 1947 at New Orleans. In 1950, Jim worked for the Pan-Am Southern Co., a subsidiary of the Amoco organization. He remained with Amoco for the rest of his career, working in New Orleans, Chicago, and finally Baltimore, when he retired in 1984.

Lawrence C. Biedenbarn, Jr., Course VIII, a class VP, died in Austin, Tex., on February 12, 1996, after a long bout with cancer. He earned both SB and PhD degrees at MIT, the latter after the war. Larry then embarked on a lifelong academic career on the faculties of Yale, Rice, and Duke Universities. He retired from Duke in 1993 as the James B. Duke Emeritus Professor of Physics. Since 1992, he had been adjunct professor of physics at the University of Texas at Austin. He was also



Marjory and Dick Whiffen, '44, visited the New Zealand Maori Arts and Crafts Institute in Rotorua late last November with 42 other alumni/ae and guests as part of the MIT Alumni/ae Travel Program. New Zealand historian and lecturer Don Stafford, with expertise in Pacific peoples, their migrations, customs, and languages, spoke fluent Maori and led the tour through the Institute. The New Zealand-made film, Once Were Warriors, recently shown in U.S. theatres, traces the heritage of the Maori people.

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editor of the *Journal of Mathematical Physics* for many years. He could discourse on a wide range of subjects while maintaining interest without overwhelming his listeners. Larry is survived by his wife, Sarah, son and daughter-in-law John and Tina, daughter Sally, and grandchildren Lauren and Johnny. This notice on Larry is poignant to both co-secretaries not only for undergraduate classes shared but also for basic training at Camp Crowder and for OCS at Fort Monmouth. He was an unassuming man and a fervent supporter of MIT.

The class extends its heartfelt condolences to all four families.

Our class is planning a mini-reunion on October 6-9 at the Harborview Hotel in Edgartown, Martha's Vineyard, Mass. If you are interested, call Lou Demarkles, (508) 778-6131, or Norm Sebell, (617) 821-2988. Don't delay and let's hear from you.—Co-secretaries: Louis R. Demarkles, 77 Circuit Ave., Hyannis, MA 02601; Frank K. Chin, 221 St. Paul St., Brookline, MA 02146

45

Although there is still snow in our front yard, it will be summer when you read these notes.

John von Hemert retired February 1 as rector of St. James Episcopal Church in Louisa, Va. . . . In early December, Walt Borden of St. Simons Island, Ga., advised that he had recently spent a month bird-watching in the eastern half of New Guinea, which included arduous hiking

on steep, rocky, muddy trails and very primitive camping. It was in 1938 that cannibalistic tribes were first discovered there; many tribesmen still only wear loincloths.

Art Hall's January note covered 1995 activities as follows: skiing in Maine, tennis in Florida (50th Reunioners will remember Suna's wicked serve!), bare-boat chartering in the British Virgins, organizing Jacksonville's first Tuba Christmas, playing tuba at Disneyworld, going to Dallas for the first grandson's wedding, and attending Art's 50th MIT Reunion.

In our last issue, we mentioned Connie Cross's death; we now have some details as to Connie's activities from June 1945 to July 1995. Connie, a Utica, N.Y., local, married Roger Robbins in Utica on May 18, 1946, and she is survived by her husband, two sons, five grandchildren, and a brother.

After moving to Geneva, Ill., Connie earned a master's degree in computer science and worked as a programmer at AT&T and Bell Laboratory. Mrs. Robbins was an officer of the League of Women Voters, a member of the American Civil Liberties Union, and on the board of the Geneva Public Library.

You will recall that as part of our 50th Reunion celebration, we created a Class of 1945 Scholarship Fund. Our first recipient is Geoffrey Warner, a junior, from Olympia, Wash. Geoff is a physics major and—of course—maintains an outstanding academic record. He lists reading, writing, and thinking about physics, math, and philosophy as his major interests. Go, Geoff, go!

Confusion continues to reign as to the whereabouts of several missing 50th Reunion books. The situation has become so complicated, we may have to bring in Provost Deutsch and his CIA sleuths to solve the mystery. Vince Butler thinks J.J. Strnad had three books whereas J.J. thinks—but can't quite remember—he has 33! If this were our biggest problem, what a boring place the world would be!—Clinton H. Springer, secretary, P.O. Box 288, New Castle, NH 03854

46

Our 50th Reunion chairman, Bob Hoffman, and his wife, Marion, held a recent meeting on campus to consolidate plans for our reunion in Cambridge on June 6-8 and our events in Newport, R.I., on June 9-12. Attendance at that meeting included Diane and Jim Craig, Glen Dorflinger, John Gunnarson, Marj and Ted Henning, Ted Heuchling, Herb Oedel, and Ned Tebbets. From the Class of 1946, we expect to have an impressive array of Cardinal Red Blazers for the Commencement Procession on Friday June 7. You should have extensive details on our reunion itinerary in recent MIT mailings.

Under the chairmanship of Ted Heuchling, the 50th Reunion Gift Committee is close to reaching our ambitious fund-raising goal of \$4 million. Thanks for all your help so far. Please mail in pledges soon, if you have not already done so.

In a recent *Technology Review*, there was a full-page picture of Rick Adler and his wife, Barbara. They have been generous supporters of the MIT Life Income Funds. Rick is an independent engineering consultant in the ship-building industry. They live in New Orleans, La. . . . Doug Crinklaw reports that

he is a semi-retired avocado farmer. He is living in Fallbrook, Calif. . . . Stan Droski is the semi-retired president of Droski, Lindsay & Meyers in Grand Rapids, Mich. He spends time in homes in Florida and Ireland, does a lot of farming, and loves golf. He sees the Rev. Earl Dionne of Milwaukee, Wisc., a few times each year.

A recent letter from Jack Knauss states that he and his wife, Lynne, have homes in La Jolla, Calif., and Rhode Island. In the Bush Administration, he was undersecretary of commerce and head of the National Oceanic and Atmospheric Administration. Jack is revising and updating his oceanographic textbook. He was recently elected president-elect of the American Geophysical Union. . . . Bob Nelson and his wife, Marianne, are living in Lompoc, Calif. They have been traveling a lot. Bob volunteers as treasurer of the Lompoc Museum and expects to attend our 50th reunion.

Anton Frank Zagar died on November 21, 1994. He had lived in Vancouver, Wash., and was retired from the U.S. Army Corps of Engineers. He is survived by his widow. . . . Louis Wright Roberts died on November 3, 1995. Louis was an acclaimed physicist and was one of the key figures involved in the founding and development of microwave theory. He held a variety of senior positions with the U.S. Department of Transportation Systems Center in Cambridge, Mass. He had recently lived in Wakefield, Mass., and is survived by his wife, Mercedes.—Ned Tebbets, secretary, 9 Jerusalem Road Dr., Cohasset, MA 02025-1100; tel: (617) 383-1662

47 50th Reunion

We had one of Abbot Fletcher's periodic and always interesting letters this month.

Last summer Abbot and his son and older daughter came in third in the annual Marion-Bermuda race on their sloop MAJEK. But the really interesting adventure Abbot described was his participation in the MIT-sponsored adventure to the South Pole last December. They started from Punta Arenas on the Magellan Strait, flying 1,800 miles in a C-130 to



Abbot Fletcher recaptures his Northern Hemisphere orientation at the South Pole.

base camp at Patriot Hills on the Ellsworth Range. Then on to the Pole in Canadian Twin Otters, carrying full survival supplies in case the plane was forced down by bad weather. At the Pole they went through the scientific buildings and learned about the various experiments going on there—studies of CO₂ and CFC's in the atmosphere, research on global warming, etc. Shortly after that, Abbot and Eileen spent a week on a schooner in the Virgin Islands—probably to warm up! Abbot also tells us that he and Eileen have already put our 50th Reunion (June 1997) on their calendar.

Louis Goodman has written nine books on engineering and integrated management systems, and has just completed a new book showing how these techniques can be applied to government—*America at the Crossroads*. He spent the last 13 years of his "full-time" career with the East-West Center in Honolulu as administrator and researcher. He now lives in West Palm Beach, Fla. . . . **John Wittels** and his wife are retired in Tucson, Ariz., and enjoy traveling, mostly in the Southwest. They recently bought a small condo in Lake Havasu and "hope to get to Boston in the next year or two." Make it June of next year, John, for the 50th! . . . We have been informed that **George Breitweiser** died in September 1995 in San Diego—no further information.—**R.E. "Bob" McBride**, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

48

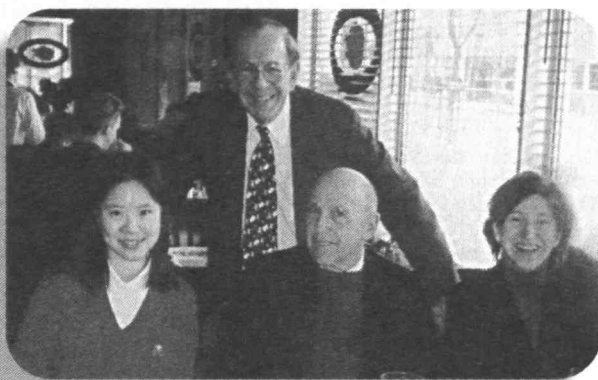
Dick Baker and his wife, Joan, still occupy the same house in Mamaroneck, N.Y., with a major difference. There are seven empty

bedrooms now that their seven children are grown. Dick continues in the manufacture of men's suits in Manhattan with a crew of from 12 to 17 tailors. His firm provided all the suits used for the cast in a major 1995 Christmas Show at Radio City in Rockefeller Center. Dick and Joan will spend a month on Cape Cod in July. They are considering acquiring a home near Raleigh-Durham, N.C. . . . **Harry Jones** has maintained his contacts and arranges purchases and sales of businesses. Every Tuesday he takes off and hikes with a group of men who have similar interests. . . . **Don Noble** works five days a week at Noble Associates (33 years old). He and his son, Craig, are expanding their second business, Building Automation Systems, a company (started years ago) that specializes in automatic temperature control, energy management, and service to large commercial buildings. Craig has and is building this company to new highs. Don says he'll keep working and may wind up getting fired by his own son. Don's wife, Nancy, teaches English as a second language in the Hingham school system. All of her teaching is one-on-one. On Wednesdays, she still does Noble Associates bookkeeping at home as she has for 25 years.

Charles Steffens and his wife, Jolly, are still flying their 34-year-old Cessna 180 seaplane—two trips from Connecticut to Alaska since 1990. They visited their son, a foreign com-

mercial officer at the embassy, and his wife in Moscow, Russia. Charles says retirement from Pratt and Whitney is "hard work." . . . At age 84, **Barney Devins** says old age is taking its toll. He wife is recuperating from a bad fall that left her with lots of pain, a broken hip, and a broken elbow. . . . **Bill Oard** has been retired since 1990. He is auditing classes in marine science at the University of South Florida, volunteers at All Children's Hospital, flies around the country, and is working on a commercial glider rating.

Al Levenson died in a nursing home in Andover, Mass., after an illness that had caused major breathing problems. Al attended several of the Champagne Brunches at Endi-



The May/June Class of '48 column described a luncheon with Christine Chan, '98 (left) and Anthony Ives, '96, who receive financial aid from the Class of 1948 Student Financial Aid Fund. The photo was taken after Anthony left, and also includes Marty Billett (standing), Denny McNear, and Sarah Gunter of the Alumni/ae Association. Anthony wrote the following: "Thanks to the Class of 1948. I would not be able to attend MIT, the finest institution in the world, without your support." Anthony recently implemented MIT's first-ever community service spring-break program. Twenty five students from MIT went to Washington, D.C., and taught lessons ranging from biosystems of fish to the physics of toys in space to 40 different classrooms in elementary and middle schools. While in Washington, they stayed with MIT alumni/ae who volunteered their homes. "I will always be grateful for the wonderful opportunity you have provided me!" Anthony wrote.

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cott House, the last in December 1994. Hopefully, an obituary will arrive with more information.

Please send news for this column to: **Marty Billett**, secretary, 16 Greenwood Ave., Barrington, RI 02806; tel: (401) 245-8963.

49

Although **Clyde Brindley** practiced as a physician for a number of years, he is now a cattle-rancher in San Saba, Texas. I have no further clues about Clyde, but wish I did.

For their hard work and devotion to the welfare of the Institute, some wives of various committee members deserve Bronze Beavers in their own right. One such is Pam Ligor, wife of Class

ClassNotes

President **Demetre P. Ligor**. In early March, Pam suffered a vicious fall down the cellar stairs resulting in bone chips in her right wrist, loss of hearing in her left ear, and serious imbalance when walking. I'm sure the class joins me in hoping she will be completely recovered by the time these words appear in print.

A feature article on the front page of the *Boston Globe* Business Section for March 19, 1996, calls colorful attention to the way in which **George Hatsopoulos's** financial empire has grown. The illustration shows a central planet (Thermo Electron Corp.—George's creation) surrounded by 18 colored globes, each representing a Thermo Electron Corp. spinoff. For more than 10 years, 12 of the companies represented by the colored globes have produced an average annual return of more than 32 percent. In referring to all his companies, George says: "It's like the Bible says: multiply."

Some of you may know that the Class of 1949 maintains and supports the Class of 1949 Scholarship Fund. And each year in early spring, the Institute, on our behalf, looks for worthy students whose continued studies may well depend on a helping hand. That's where we step in. Fund recipients continuing from last year are: Andrew Beechum, '96; Jodi Krawczyk, '98; Maish Richard, '96; and Rosanne Rouf, '97.

Andrew is continuing to major in electrical engineering and computer science with an eye toward computer science employment in the film industry.

Jodi, who describes herself as an environmentalist, worked last summer as an intern for Scripps Research Institute in La Jolla, Calif., in their molecular biology lab.

Maisha will graduate in June with a major in civil/environmental engineering. For the last two summers, she has worked as an intern with Shell Offshore, Inc., in New Orleans. During the term, she has a UROP job assisting MIT Project on Environmental

Politics and Policy.

Rosanne continues to major in electrical engineering and computer science. Last summer she worked with MIT's Media Lab as a programmer. Very active in cultural activities, she continues a cultural director for the South Asian American Students Association.

New this year are: **Jared E. Bibler**, '96; **Maria Kamvysselis**, '98; **Marissa L. Martin**, '98; and **Aleksey Zinger**, '97.

Jared will graduate this June with a major in mechanical engineering. Last summer he was an engineering intern at Lawrence Livermore National Laboratory. He is a member of the MIT Concert Band, a member of Tau Beta Pi, Pi Tau Sigma, and a volunteer teacher in the Cambridge schools.

Maria, originally from Athens, Greece, but

now a permanent resident, has switched from economics to mechanical engineering with an accompanying change of career goals from an economics/MBA orientation to joining industry and getting a BS/master's in mechanical engineering.

Marissa is a sophomore from Tacoma Wash., majoring in brain and cognitive sciences who would like to make her career in engineering. Last summer she worked as a cashier at Wal-Mart in Columbus, Ga., and has been working for dining services on campus this year.

Aleksey, who comes originally from Moscow, but is now a citizen, is a junior majoring in mathematics. He hopes to teach and do research at the university level after earning a PhD. Last summer he was a lab assistant at the Scripps Institute of Oceanography in La Jolla. During term time, he has a job grading physics 8.02 papers.

Donald Ramsey has retired after 40 years with General Motors Corp. as a senior compliance engineer and two years as a division head/supervisor, Town of Chili, Rochester, N.Y. Donald is a past president of the MIT Club of Rochester, on the board of trustees of his church, and a past county commander of the VFW. His wife, Suzanne, is a psychiatric nurse at Strong Memorial Hospital of the University of Rochester. Their three children are grown and working.

Some of you may remember that the May/June '96 issue of these notes referred to the passing of Parker Painter in June 1993 and that I felt badly that there was no further information on him. An obituary from the Ocala, Fla., paper has reached me (three years

late) providing the following background. Parker was a retired electronics executive. A native of Ocala, he returned to Ocala in 1979. He served as radio operator in the 34th Bomber Squadron during WWII, was founder and president of Dynatronics, Inc., Orlando, and general manager of the Electronics Division of General Dynamics. Survivors include his wife, daughter, three sons, three grandchildren, and a sister.

I am saddened to report that an obituary for William Henry Connolly of Sudbury, Mass., has appeared in the July 13, 1995, *Boston Globe*. William Connolly, a retired structural engineer, died of lung cancer on July 10, 1996. Born in Boston, he graduated from Boston Latin School and interrupted his studies at MIT to serve in the Navy during WWII. Following the war, he returned to MIT, and graduated in 1949 with an SB in engineering. He was a structural engineer with Zaldastani, Inc., Boston, for 20 years until his retirement in 1993. Connolly spent much of his spare time developing sports-related equipment for people with disabilities and volunteering at the Perkins Institute for the Blind. He leaves his wife, Gloria, three sons, a daughter, his mother, two brothers, and a grandson.

Dr. Samuel Goldblith, '40, MIT professor emeritus, writes: "I was asked by his widow to inform you of the passing on January 31, 1996, of Joseph A. Stern, who received an SB in Course XX, food technology." Dr. Stern held upper-management positions at the Boeing Co., and NASA's Jet Propulsion Laboratory. Among many distinctions, he was considered the foremost expert in contamination and decontamination of interplanetary vehicles. He

had received numerous recognitions for his pioneering work in the biological aspects of people in space and in the air from NASA and other organizations. He is survived by his wife of 45 years, Phyllis, two daughters, and one son.—Fletcher Eaton, secretary, 42 Perry Dr., Needham, MA 02192; tel: (617) 449-1614

50

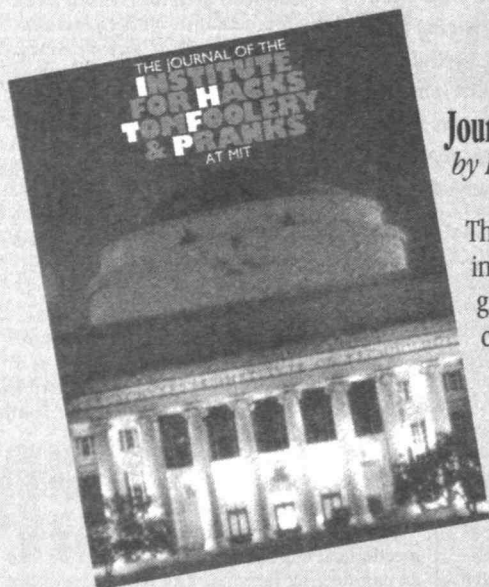
The class of 1950 has reached the Internet thanks to our classmate Lindsay Russell.

Lindsay set this up at the address <<http://web.mit.edu/alum/www/Class/mit1950>>. If

any of you web surfers care to visit our home page, you will find you can send me news for this column very easily. Please do.

At our reunion last year Bey Blanchard told me he had volunteered as a walking scorer for the U. S. Senior Open Championship at The Canterbury Golf Club in Cleveland on July 4 through 7. He will carry a clipboard and walk down the fairway behind one of the groups of players. Since the event will be on NBC-TV, I am offering a prize to the first classmate who tells me for which group of players Bey scores. The prize will be two glasses (wine or tumbler) with the MIT logo thereon. The three ways to reach me are at the end of this column. . . . I spent two days in San Francisco visiting my daughter and while there I was able to reach Jay Willner. He runs a consulting operation with clients in the U.S. and Europe. Jay told me he has no plans to retire, ever. His expertise is in anti-corrosive coatings and business planning. He is helping his son develop a business plan for an upscale restaurant. His non-

Hack \ˈhak\ *n* 1: A prank, usually elaborate. *v* 1: To perform a prank. 2: To explore the places on campus that are not usually accessible. 3: To work at or study a subject not especially for academic gain.



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business travel has taken him to Australia and New Zealand. . . . In the February 18, 1996, *San Francisco Chronicle and Examiner* I saw an advertisement for Dick Bolles's book, *What Color is Your Parachute*, which he revises each year (over four million copies in print), and a seminar based thereon.

From San Francisco we went to the Monterey Peninsula for February. There I contacted Don Gaver who has taught at the Naval Post Graduate School in Monterey since 1970. He teaches math and does research. Prior to that he worked at Westinghouse and Carnegie Mellon. Don's son, William, was quoted here in *Technology Review*. Don's travels have taken him to Alaska, Australia, and Hong Kong, and he looks forward to visiting New Zealand. He keeps in contact with Dirk de Vries in Minnesota and remembers his classmate Jack Hetherington, both Sigma Nu brothers. . . . My wife's Wellesley alumnae magazine reports that Peggy and Les Allison "made a 'roots' journey to India with their children, children's spouses, Les's two sisters, and a niece, an even dozen." (I hope Ed Perkins got them quantity discounts.) "Les was the child of missionaries and grew up in India, leaving after the 12th grade. Among the highlights were visits to the secondary school that Les and his sisters attended in the foothills of the Himalayas; a stop at the house in Gwalior, where the Allison family lived when Les was a boy; and the Taj Mahal, glowing at sunset and 'really incredible—so graceful and serene, even though you've seen so many pictures of it,' said Peggy. In Gwalior, the group was put up in the manager's quarters at a hotel, once a maharajah's guest palace, after common ties were discovered. The manager had gone to the hotel management school at the UNew Hampshire, and Les and Peggy live in Grantham, N.H."

A press release from Wheat International Communications told me that Bob Plouffe retired last December from his position as senior VP. He had been with Wheat since 1990. He previously held senior positions with several firms in the telecommunications and information technology field including CONTEL and ITT. This was not his first retirement nor his last. Bob has since formed a company to provide engineering services to Personal Communications System, a competitor to cellular telephones. His company will also provide security services to online corporations worried about hackers. Bob and his wife live in McLean, Va., and have celebrated their 47th wedding anniversary. . . . Gerry Lessells writes from Tucson: "After nine years of retirement, I am now keeping my technical hand in by volunteering one day a week at U/Arizona Chemical and Environmental Engineering Dept." Gerry is "having a ball" upgrading the laboratory equipment "hands-on, no paperwork." . . . Don Taylor writes from Toronto that he is involved with Management Advisory Services, a group that helps nonprofit agencies in Toronto manage to survive the "extreme difficulties due to massive cutbacks in government funding." Canada has some of the same problems as the U.S. . . . On a happier note, Fred Messina writes from Danvers, Mass., that he has qualified for the '96 Boston Marathon. Good luck, Fred. The race will be over and Fred's success will be

known by the time you read this attempt at bonhomie. I shall try to learn and report the result. Are any other classmates still running marathons?—Robert A. Snedeker, secretary, Seven Mashie Way, North Reading, MA 01864; tel: (508) 664-1738; e-mail: <103244.1541@compuserve.com>

51

By the time you are reading this, we will be reminiscing over the wonderful time that many of us had at our 45th Reunion. We will be recalling how lovely the site and accommodations were at the Black Point Inn at Prouts Neck in Maine and the warm and enjoyable banquet held there. Our minds will turn to the Cambridge portion with its Tech Night at the Pops, the very enjoyable talk presented by Dr. Bob Rose at the Friday evening banquet, and the stimulating Technology Day. Most of all, we will be thinking of how great it was to see so many of our classmates again and resolving to be at the BIG FIFTIETH which is not so far off. We are all indebted to our reunion chairman, Bill Cavanaugh, to Fred Ezekial, and to their entire committee for providing us with such a memorable time.

After 44 years of architectural practice, Lawrence E. Bray has transferred his firm, Bray Associates Architects, to three of his children. The 50- person firm was established in Sheboygan, Wisc., in 1962 and has designed over 900 school projects in addition to many other buildings in Wisconsin and Minnesota. . . . Recognizing his significant contribution to the field of mechanical engineering, Dr. Eli K. Dabora of Storrs, Conn. has been named a Fellow of the American Society of Mechanical Engineers. He is also a member of the American Association of University Professors, the American Institute of Aeronautics and Astronautics, the Combustion Institute, the Society of Automotive Engineers, Sigma Xi, and Tau Beta Pi.

As president of the Gabriella and Paul Rosenbaum Foundation, Madge Goldman, who lives in Bryn Mawr, Pa., has directed the funding of three graduate student fellowships in MIT's Mathematics Department. . . . Moving to Jackson, Wyo., following their respective retirements, Peter M. Lang tells us of how enjoyable the Jackson Hole area is in both the summer and in winter. He and his wife are busier now than their life prior to retirement.



Virginia & Raymond Atchley, '51, in New Zealand late last November.

ClassNotes

. . . Pete Silveston commutes between his job in Canada and his house in Kiawah Island, S.C. His latest startup company, Gargoyles and Windcocks has survived its critical first year. His academic career is about finished with the publication of his last book that will be coming out in 1996.

Having retired from the U.S. Civil Service in 1988, I. Victor Yancey has now had a second retirement. This time it is from a minority firm that enjoyed his services without any compensation. He and his wife, Catherine, have moved to a ranch-style house from a two-story farmhouse with over five acres in order to ease her recovery from a stroke in 1994. He is keeping active in several church activities, fraternity programs, and volunteering.—Martin N. Greenfield, secretary, 25 Darrell Dr., Randolph, MA 02368; e-mail: <greenfld@tiac.net>

52

45th Reunion

Stan Gelles writes that he has been active in his own metallurgical services and asbestos analysis laboratory business for 20 years now in Columbus, Ohio, where he and his wife Rhoda reside. Their children are grown and scattered to Boston, Cincinnati, and Chicago, but have provided them with three delightful granddaughters in the past year and a half. Stan says he spends some time in Grantham, N.H., each year, and travels when he has the opportunity. . . . And Bruce Curry writes that he has been working on a management control system for the FAA in Washington as VP for marketing of Business Research Institute of Stowe, Vt. . . . James Stockwell says that after leaving MIT and serving in the Air Force, in 1957 he cofounded and later became president of a pioneering computer graphics company. He then had a 19-year second career as partner/director of an executive search firm, from which he retired in 1993. He now devotes his time to a host of hobbies and home projects in a stress-free retirement, while still serving as a director of a bank and a career mentor to Sloan School graduates. His wife is a published poet and painter, and they have five children and four grandchildren. . . . Julio Franzini, who has served many years as the president of the MIT Club of Uruguay, has resigned that post because he has been appointed ambassador to Egypt from Uruguay.

Christian Anderson, Class of 1952 Scholar, sent a graceful letter of thanks to the class through Class President Bob Lurie. In his reply, Bob noted that many of us had benefited from scholarships, and that he was sure that when Chris was in our position, he too would feel the obligation to "pay back" by helping future students.

Bob's view of our position was that of imminently celebrating our 45th Reunion, which we will do October 24-28 in Hershey, Pa. Many have made plans to attend, and the more of us who come, the better it will be.

I was saddened to learn that Steve Spacil

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died December 8, 1995, in a water accident. Steve studied physics as an undergraduate, and received master's and doctoral degrees in metallurgy from MIT. He worked for GE Research and Development Laboratory in Schenectady from 1959 until his retirement in 1993. In 1979 he was appointed scientific representative for Asia, and resided in Tokyo. He worked on a large variety of projects for GE in metal processing, high temperature chemistry, and electrochemistry, applied to carbide tools, alkaline batteries, electrochemical sensors, discharge lamps, gas turbines, soil chemistry, and process modeling. He had received 22 patents. After retiring he divided his time between St. Croix, V.I., and Schenectady. He is survived by his wife Jessica, a daughter, a stepdaughter, a stepson, and three grandchildren. . . . We also have the very belated news that Oscar Semb died December 31, 1983.—Richard F. Lacey, secretary, 2340 Cowper St., Palo Alto, CA 94301; e-mail: <rflacey52@aol.com>; listserv: <mit1952@mitvma.mit.edu>

53

James P. Johnston reports that he became professor emeritus of mechanical engineering at Stanford University in 1994. His specialty is complex turbulent fluid flow. He can be reached via e-mail at: <johnston@stokes.stanford.edu>.

We have just now learned of the death of Paul Meretsky in 1987. He was survived by his daughter, Natalie Lebeau. We have no other information.

David Cravens, professor of marketing at Texas Christian University's M. J. Neeley School of Business, has been named Outstanding Marketing Educator for 1996 by the Academy of Marketing Science. David has been in the TCU Marketing Department since 1991 and is the recipient of numerous awards as well as being the editor of *The Journal of the Academy of Marketing*, University of Washington. He published two articles in *Nature* in 1995 and, as of March, was on a nine-month-long sabbatical, his first since he began teaching at MIT (10.17. Does anyone remember the course title?) over 40! years ago. . . . Joe Cahn and Bill Haberman, together with their wives, spent a week skiing in Utah at Park City and Deer Valley and had a wonderful time. Next year, they will actually qualify for senior lift tickets. How about a ski trip reunion?

This is your column. Please write to me and tell me what is happening in your life. Use the mail, phone, fax, or e-mail to: Joseph M. Cahn, secretary, 20 Ocean Park Blvd., Unit #9, Santa Monica, CA, 90405; tel: (310) 396-6322; fax: (310) 553-0687; e-mail: <jmc20@aol.com>

54

Dick Tooley sends a most welcome letter expanding on the information we reported two issues ago. When he and his wife, Marita, visited Karen and Jim Hyde a year ago, they had a tour of the lab where Jim is doing some very interesting work, using magnetic resonance to probe the functioning of a living brain. Jim is apparently among the few of us who have not retired. And this spring, Dick

and Marita toured Australia and New Zealand. Now that he has retired, Dick keeps out of trouble sitting at his computer and organizing the results of his lifelong interest in photography. . . . Word has arrived that Tom Gibbs retired from Du Pont in 1990 and has been working with the Materials Technology Institute (MTI) of the chemical process industry. Last September, he was appointed executive director of MTI.—Edwin Eigel, Jr., secretary, 33 Pepperbush Ln., Fairfield, CT 06430

55

Lester Lee is still working with the Department of Energy in Washington and is looking forward to children's weddings, grandchildren, and retirement, though, he says, in no particular order. He reports that the photos on his desk of the 1990 '54-'55 crew reunion still draw much more flattering comments from his DOE colleagues than those of the workmen on the Harvard Bridge as they passed underneath it. He also enjoyed the 40th Reunion, but says that for the 45th, he'd just as soon have someone row him (as cox) or possibly just ride in the launch.

Speaking of the 40th Reunion, since really fresh news seems to have temporarily dried up, we'll continue to publish a few excerpts in each issue from the terrific Reunion Yearbook put together by some of our hardworking classmates for that event (incidentally, a few copies are still available from our treasurer, Paul Attridge, for anyone who may have missed getting one). . . . Arnold Langberg is currently working with the Colorado Governor's Office of Community Partnerships on Education for Moral Courage and is involved with a group of community activists from Chicago, New York, Philadelphia, Denver, Seattle, and Los Angeles on a cross-city campaign for urban schools. Arnie has been intensely involved with secondary-school education since 1955—teaching mathematics at his hometown high school in Lynbrook, N.Y.; helping to create The Village School, one of the first public alternative schools in the United States; moving to Colorado and starting the Mountain Open High School and serving as administrator of alternative education for the Denver Public Schools; helping to develop an alternative high school for at-risk inner-city students; and writing the draft of what became Colorado's Charter School Law. Arnie won the Colorado Governor's Award for Educational Excellence in 1991 and an award for moral courage in 1993 by Samaritan House, *The Denver Business Journal*, and Denver University. He and his Latvian-born wife, Dagnija, have bought an eight-acre farm just outside of Riga, Latvia, taking advantage of Latvia's newly re-won independence, and spend as much time there as they can manage. They have three children and live in Evergreen, Colo.

Dell (Lanier) Venarde lives in Wilmington, Del. She gives outdoor programs for children in two local nature centers, serves on the boards of Friends of Music and Dance of Swarthmore College and of a halfway house for homeless women, as well as in other church-related capacities. After about a year in industry and another in a university engineering department, she received a MEd from the University of Delaware and turned to

teaching math and physics to 9th graders up to college freshmen. She and husband Jack like to travel and to hike. Their two children, offsprings of two chemical engineers, have turned out to be a medieval historian and a clinical psychologist.

Please send news for this column to: Co-secretaries: Roy M. Salzman, P.O. Box 197, Rockport, ME 04856; James H. Eacker, 3619 Folly Quarter Rd., Ellicott City, MD 21042

56

Howard Trachtenberg reports happily that he and his wife, Carol, became grandparents for the fifth time with their first granddaughter. Howard is chairman of the Department

of Anesthesiology at Baystate Medical group in Springfield, Mass. Howard's leisure time is spent at ski patrol duties in the winter and golf and fly fishing in the summer. . . . Martin Reiss is president and CEO of RJA Co., with nine offices throughout the country doing fire protection engineering consulting services. He has just been elected vice chairman of the National Fire Protection Association Board of Directors. . . . I regret to inform you that Elmer J. Korn passed away May 14, 1994.—Ralph A. Kohl, co-secretary, 54 Bound Brook Rd., Newton, MA 02161; e-mail: <kohl@ll.mit.edu>

the President's Award from the California Pro Life Council.

Richard Glantz has returned to Lexington, Mass., from an overseas assignment in Hong Kong for Digital Equipment where he is now an engineering manager in their personal computer group. He recently celebrated his 20th anniversary with Digital. He started there working on innovative (at the time) computers the size of a living room. Now his innovative product is a laptop small enough to fit into an interoffice envelope! He observes, "Funny thing: even though the technology has changed, the problems a manager faces in getting a quality product out on schedule and within budget remain the same, albeit with considerably less slack time to cover the unforeseen."

Richard doesn't spend all of his time at the keyboard. He and wife, Judy, deliver meals to the needy. He is also acting chairman of the Board of Overseers of the Bank of Boston Celebrity Series, a nonprofit organization bringing classical and contemporary performing arts to the area.

During the spring of '96, Kenneth Langley was on sabbatical leave from the Physics Department at UMass/Amherst. He spent the time at Royal Melbourne Institute of Technology, Melbourne, Australia, working on light scattering from colloidal dispersions. Considering the difference in time zones there were probably a few sleepless nights spent following the fortunes of the UMass basketball team in the national championships as well!

Please send your news to: Gary Fallick, secretary, 4 Diehl Rd., Lexington, MA 02173; e-mail: <fallick_gary@waters.com>.

ClassNotes

59

A life-change note from Martin King says that he has retired after practicing medicine (pathology) in Corpus Christi, Tex., for about 20 years. Martin now lives by the

Gulf of Mexico, has two grown boys, 24 and 26, and is traveling, reading, skiing, and keeping in touch with friends including Alan Barr, Al Vasquez, Dave Root, Larry Sprechman, John Brauman, and Jack Rhodes. Sounds like Martin may be our leading "stay-in-contact" person! Thanks for the update, Martin.

Bob Polutchko reports, "Well, another merger to assimilate! Lockheed this time and we Martin Marietta were just about completed in "digesting" General Electric Aerospace and General Dynamics Launch Systems. Believe it or not, we seem to still have a ferocious appetite! Best regards to all."

John A. van Raalte communicates from France, where he works for Thomson Consumer Electronics (who bought RCA in the United States) as general manager of the electron-optics lab. He says, "We enjoy visits from family and friends including a number of MIT compatriots." He ends by saying that he spends Christmas with family and children in the United States and is enjoying the "French Experience."

Finally, Bob Broder has become co-owner of Monacelli Associates, an architectural

57

40th Reunion

Please send news for this column to: John Christian, secretary, 7 Union Wharf, Boston, MA 02109; tel: (617) 227-7521; fax: (617) 720-4694

58

We were saddened to be notified that Lew French died October 24, 1995. He resided in Pearland, Tex., and was the owner of High Basin Capital, Inc. Lew was a graduate of

Course X and was active in the MIT Club of Texas. No other information was received. Our sincere condolences to his family.

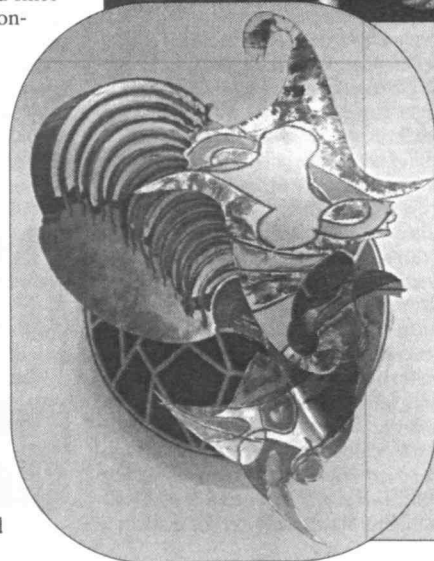
Kenneth Mitzner retired from Northrop Grumman at the beginning of 1995 and since then has been busy starting up a new consulting business, Mitzner Science & Technology in Torrance, Calif. His business card features the motto "Electromagnetics With Insight" and lists his specific areas of expertise as low observables, materials and measurements, antenna and radome concepts, analytical and numerical methods, and phenomenology. After receiving an SB in electrical engineering, he earned MS and PhD degrees at Caltech. During his career at Northrop he became a Fellow, IEEE.

Kenneth and his wife, Ruth, have three daughters. Kenneth notes that his primary avocation is his long-term involvement in the right-to-life movement. According to his profile in the 1996 edition of *Who's Who in America*, he has written handbooks and articles on the subject and received



There is art that hangs on the wall, such as Frank Stella's Heads or Tails, at left below, which now graces the Amherst Street entrance to MIT's newly dedicated Tang Center for Management Education. And then there is art that covers

the walls, which describes Stella's playfully named Looooloo (above), which extends 10 feet from floor to ceiling and 97 feet around the walls of the conference room in the School of Architecture and Planning. The two works have been sited at MIT thanks to the generosity of Elliot Wolk, '57, shown at right above with the artist when both were on hand for the dedication of the conference room. Stella is described by Sloan School Dean Glen Urban, himself a sculptor, as "one of the best contemporary sculptors alive."



TURING AWARD GOES TO MANUEL BLUM, '59

Considered the Nobel Prize of computing, the A.M. Turing Award goes this year to Manuel Blum, '59, PhD '64, in recognition of his contributions to the foundation of computational complexity theory, a field that strives to understand the capabilities and limitations of computers that use a reasonable amount of time and memory. The subject includes the study of cryptographic protocols, efficient algorithms, and computational problems that are hard to solve.

A native of Caracas, Venezuela, Blum is now the Arthur J. Chick Professor in Electrical Engineering and Computing Sciences at UC/Berkeley, where he has been a faculty member since 1968. His MIT degrees include an SB and SM in electrical engineering and a PhD in mathematics.



The Turing Award is given annually by the Association for Computing Machinery (ACM) for technical achievements in the field of computing that are deemed by a jury of leading professionals to be of lasting and significant importance. It is accompanied by a prize of \$25,000 (contributed by AT&T) and was presented in February in Philadelphia, in a special award ceremony that also launched ACM's 50th anniversary celebration.

Blum's mentors at MIT were Richard Schoenwald, Warren McCulloch, Hartley Rogers, Jr., and Marvin Minsky (who in 1969 was one of the early winners of the Turing Award). During his career, Blum has advised 26 PhD students, three of whom—Shafira Goldwasser, Silvio Micali, and Michael Sipser—are currently professors at MIT. □

urban-design firm in Cambridge with a general practice, which is doing the program management of the Commonwealth's (Mass.) prison expansion project, in which he is the chief programmer and security expert.

That's it for now. I continue to ask, and implore you to *actually do it*—send an update, which will be most appreciated by your classmates. Hope to hear from you soon. —Dave Packer, secretary, 31 The Great Rd., Bedford, MA 01730; tel: (617) 275-4056; e-mail: <70421.1766@compuserve.com>

60

Richard Higgins writes from Atlanta that he is directing a new program at Georgia Tech—Global Innovation for Engineers. Dick notes that this National Science Foundation-

sponsored program will prepare engineers for careers with global companies. If you'd like more information on this two-year master's program that includes language and culture (and what Tech Tool couldn't use a bit of that), contact Dick at his e-mail address: <richard-higgins@mirc.gatech.edu>.

Al Tobin used e-mail <al_tobin@crsmtpt.grumman.com> to contact me recently with a 35-year update. Al is living in Smithtown, Long Island, and has been a materials scientist at Northrop Grumman for the past 26 years. Al and his wife Linda have two sons, Michael and Danny. Linda is a reading disabilities specialist and teaches in the local community college. After getting a master's at Tech in '63, Al got his PhD in metallurgy at Columbia in '68 and after a short stint at Union Carbide, landed at Grumman the year we landed on the moon. . . . Richard McDowell writes that he has been elected president of the Orange County, Calif., Forum. Dick is also the chairman of the board of trustees for the Family Solutions, Residential, and Foster Care Pro-

gram for abused kids. Like many academics, Dick is also busy fund-raising as dean of Chapman University's business school. . . . In a recent note to me, Kern Kenyon writes from Del Mar, Calif., that he has devised a way to understand certain weather patterns that form over the North Pacific and then drift over North America. He is hoping that his discovery will have practical applications, and has submitted the work for publication for the first time. However, Kern says, "I am patient when it comes to rejections."

Sheldon Epstein also can be contacted via e-mail <k9ape@eecs.nwu.edu>. Shel informs me that he and Suzy celebrated their 35th anniversary in June. In 1994 their daughter, Liz, made them the proud grandparents of Max Jacob Geifman, just a few hours before Shel's 56th birthday. Shel's engineering firm, Epstein Associates, continues to prosper by building custom automatic video image analysis parts inspection systems for mass-production factories. Shel is also an adjunct professor in Northwestern's Department of Electrical Engineering. You may learn more of Shel's course in engineering design and entrepreneurship at his home page: <http://web.eecs.nwu.edu/~k9ape/index.html>.

Also reaching me from cyberspace is Chris Witze <witz@eplus.de>, who is currently in Dusseldorf, Germany. After earning a PhD in nuclear engineering from Berkeley, Chris has evolved into an authority on cellular phones and has started several mobile phone companies in the U.S. Chris and his wife, Carol, then sold their house, car, (and kids?) and became expatriates traversing the globe. To pay for their peripatetic lifestyle, Chris has been working for cellular startup ventures in Australia, New Zealand, and currently Germany. They expect to head for Brazil later this year and then return to New Mexico and settle down for awhile, as Carol is getting tired of rented furniture and Chris wants to lower his golf

handicap. But, writes Chris, if something interesting comes up, they'll hit the road again—it's a more interesting life than retirement.

A postcard comes from Bruce Layton in Ithaca, N.Y. Bruce has taken early retirement from Raytheon, sold his home, and leased a town house across the street from his parents. . . . Finally, "Don't-Even-Think-About-a-Leash" Fred Kayne sent me a colorful brochure describing Big Dog Sportswear, his casual apparel company built around a sophisticated big dog with an attitude. After MIT and the Army, Fred moved to Los Angeles where he first was in real estate then the stock market business. He resigned as director and principal of Bear Stearns in 1986 to become the principal in several businesses, one of which is Fortune Fashions with its Big Dog line. Fred says they have 100 retail stores across the country, a loyal mail-order following, plus specialty and department store customers. Fred concludes by saying, "It is a long way from calculus to Big Dog, but the journey has been fun!" I bet it has!

Keep those cards, letters, and e-mail coming.—Frank A. Tapparo, secretary and class agent, 15 S. Montague St., Arlington, VA 22204; e-mail: <ftapparo@lmi.org> or <ftapparo@aol.com>

61

Please send news for this column to: Andrew Braun, secretary, 464 Heath St., Chestnut Hill, MA 02167; e-mail: <andrewb820@aol.com>.

62

35th Reunion

Bob Heinmiller dropped me an e-mail message with the news that he and his wife,

Susan Kubany, are in the midst of some big changes. A year ago, their company, Omnet, Inc., which for 15 years provided communications and information management for earth scientists, was hit very hard and fast by the Internet. They downsized Omnet, closed a sister company in Ireland, and shut down the SCIENCEnet service for a year while they took stock. With the encouragement and support of former customers in academia and government, they have designed a new set of services on the World Wide Web, and are about to restart SCIENCEnet. In December, Bob was honored by the American Geophysical Union with the 1995 Ocean Sciences Award for his contributions to marine science. In the process of reinventing Omnet, Bob and Susan also decided to do some personal reinvention. On April 1, 1996, they relocated after 35 years from New England to Staunton, Va., in the Shenandoah Valley. Staunton was chosen, not only for the beauty of the location, but also because there are two skydiving drop zones within an hour's drive. Bob has about 800 jumps, and last August made his first helicopter and hot air balloon jumps at the World Free Fall Convention in Quincy, Ill. Every year, Bob and Susan host their 12 nephews, nieces, and grandchildren, from 7 to 15 years old. They call the gathering "Camp Humming Tree," and this year will include a day visiting Washington, D.C. Just to stay busy, they also publish a weekly political column on the Internet at <<http://www.omnet.com/What-I-Think>>. Bob's e-mail address is <r.heinmiller@omnet.com>, for anyone interested in virtual contact.

Tony Mack picked up some information about classmate **Scott Burns** from the April, 1996, issue of *Worth* magazine. It seems that the famous investment Guru, Peter Lynch, writes a monthly column for *Worth*, one of which dealt with using dividend-paying stocks instead of bonds for a fixed 7 percent return without risking capital and achieving capital gains to boot. Our own, Scott Burns, took Peter to task for this in his column in *The Dallas Morning News* by showing that using Peter's method would have caused the total loss of capital at least once over the past 20 years. Peter Lynch, himself, acknowledged Scott's correction in his column in the April issue of *Worth*, and changed his recommendation to 5 percent income as a safer limit to withdraw from a stock portfolio. Tony says that the moral of this story is that not even the legendary Peter Lynch can withstand the critical scrutiny of the MIT Class of '62—or at least some of its members!

Tony is still in Kalamazoo at Fabri-Kal Corp. as VP of product development and quality, doing a lot of work on plastic food packaging and training in quality, team building, interpersonal skills, etc. The work place has changed greatly since the Class of '62 started their professional careers, and (according to Tony) it seems the best way to keep ahead of the competition is to train employees in basic skills, self-esteem, teamwork, and communication. He feels that this combination of training and skills really works—helping to turn the company around, sales are booming again, earnings are growing, and morale is high. Fabri-Kal is now rated the fourth largest thermoformer in North America. Tony's wife, Dolores, keeps busy by keeping him on track and doing social work for Catholic Family

Services in Kalamazoo. They are starting to consider what they want to do when Tony retires—a sure sign of getting older—where to live, etc. Daughter Jodi, is getting married in June in Danvers, Mass. Sons Chris and John are still single. Chris lives on Commonwealth Avenue in Boston, providing a nice place to visit when they are in Boston. Both Jodi and Chris are regional sales managers, Jodi for Lights of America, and Chris for Quaker State Oil. Son John recently got an ME degree from the U/Michigan, and is now studying for an MS in biomedical engineering at Drexel University in Philadelphia.

Reviewing Tony's comments, I am pleased to report that my daughter, Patricia, received an MS from Drexel last year. Now certified to teach math in Pennsylvania, she has a full-time position at one of the high schools in Philadelphia. She will be married in Philadelphia in June to Jeff Steele, a PhD candidate in physics at Drexel. Daughter Katherine is a certified management accountant and a specialist in computer auditing for BellSouth based out of Birmingham. Son Fred is a certified auto mechanic with the local Chrysler dealer in Gloucester, Mass. Mary and I will also celebrate the wedding of her daughter, Francesca C. Morgan, this July in Gloucester, Mass. Fran is marrying Charles R. Steinwedel of Minneapolis, Minn. Both are finishing PhDs in history at Columbia University. Fran is a specialist in American history, writing her dissertation on the first 40 years of the Daughters of the American Revolution; Chuck is a specialist in ethnic Russian history, writing his dissertation on ethnic minorities in Central Russia prior to the Bolshevik Revolution in 1917-1919. And, you too, can get the (unedited and unexpurgated) class news while it is still fresh, hot off the Internet. Please send your news and personal notes to: **Hank McCarl**, secretary, Box 352, Birmingham, AL 35201-0352; fax: (205) 934-1318; e-mail: <hmccarl@mail.business.uab.edu>; <mit1962@mitvma.mit.edu>.

63

Please send news for this column to: **Shoel M. Cohen**, secretary, Dept. of Psychology, Nassau Community College, Garden City, NY 11530; e-mail: <71271.2627@compuserve.com>

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64

I regret to announce the death of our classmate **Wayne R. Chiodi** (Course VI) last February 15. Wayne received a master's from Purdue and was with Zenith Electronics

for 25 years. He lived in Northbrook, Ill., and is survived by his wife, Carol, daughter Ann, and son David.

Roger Lewis (Course IV-A), <rogershome@aol.com>, reports he is still a columnist for the *Washington Post*, still a professor of architecture at the University of Maryland, and still practicing architecture. He recently designed a new middle school and is currently designing a new community (2,300 acres). His son, Kevin, is a senior at MIT, pursuing a double major in physics and political science.—**Bill Ribich**, secretary, 18 Revere St., Lexington, MA 02173, tel: (617) 862-3617; e-mail: <mit1964@mitma.mit.edu>

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65

Kudos to Billy Roeseler for his continuing communications (yes, Internet is wonderful). Billy still spends his extra moments further developing the technology and sport of

the kiteski, and can give any of you who want a fascinating story of how the kiteski compares with other methods of transportation. Perhaps Billy is a little sensitive since half his life is involved with the details of aircraft design and the other half converting that to kiteski reality. . . . Yazan Sharif has joined the board of directors of BusinessWorks, an interactive, multimedia information and training systems company located in Dallas. Yazan will serve as chairman of the company. . . . Gary Rose reports he has shifted to a new position as general manager and executive VP of Jeppesen Maintenance Information Services, a new strategic business unit of Jeppesen Sanderson (for you non-flyers, Jeppesen is a major supplier of information for pilots). Other than that, the mailbox was fairly dry this month. Please write or e-mail your news to: George McKinney, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167; tel: (617) 232-4710; e-mail: <georgemck@aol.com>.

66

Lots of news again this month. After four years in the making, Thomas B. Jones's book, *Electromechanics of Particles*, has been published by Cambridge University Press. It is a

research monograph, summarizing his research and its relationship to the work of others on the ways particles in the size range from one micron to one millimeter interact with electric and magnetic fields. The subject has innumerable connections to applications like xerography, biological dielectrophoresis, electrorheological fluids, particle adhesion and cohesion, etc. . . . Edward Sullivan was elected chair of the civil and environmental engineering department at Cal Poly, San Luis Obispo, and Martin Kaliski was elected to a second term as chair of the electrical engineering department at the same school. Martin still does his weekly radio show, *Technology and You* on KVEC-AM, San Luis Obispo.

Another educator, Robert Liberles, lives with his wife, Adina, and three daughters in Beer-Sheeva, Israel where he is associate dean of humanities and social sciences and professor of Jewish history at Ben Gurion University. . . . Bert Forbes writes that his son, Bryn, is now a freshman at Stanford. Ziotech Corp., which Bert and his wife, Candace, founded, will be 20 years old on July 14. . . . Another Californian, John Rible does contract software in Fort and designs small processors. He was editor for both the ANSI Fort Standard and the IEEE Open Firmware standards. John celebrated his 50th birthday at the roller rink last year with a skating birthday party.

Robert Morton, who had taken advantage of IBM's buyout two years ago, now works in Boston for Teradyne, Inc., although he still lives back in Poughkeepsie on weekends. That's a long commute. . . . Dennis Jedlinsky was promoted to VP for finance for Duracell's New Products and Technology Division. He notes that is an interesting career path for someone with an SB and SM in aero engineering. He and his wife, Bev, had a busy three

months. Son David (Class of '89) was married; daughter Diane gave birth to their first grandchild; and daughter Cindy graduated from Emory University. . . . Thomas Percer notes that all three of his sons are in college now, one at MIT; one at Creighton, and one at Rhodes College.

Mark Yogman's son, Larry, graduated from MIT this June with a split major in math and computer science. . . . Dr. Leonard Zacks, of Zacks Investment Research, suggests we will be amply rewarded if we check out his Web page at <<http://aw.zacks.com>>. . . . Gene Sherman, MD, has been a practicing cardiologist in Aurora and Englewood, Colo., since 1977. His wife (who is an endocrinologist) and he are in a group practice. Their two children appear headed toward medical careers as well; Jon is a second year student in the MD-PhD program at the University of Colorado. Jill is a pre-med student at the University of North Carolina. Last year, Gene completed a two-year term as chief of staff of Aurora Presbyterian Hospital. He has served for more than 10 years on the board of directors of FHP of Colorado, the largest HMO in the state. He also completed his 10th year of Sports Car Club of America racing. He has raced a Spec Racer or a Spec Racer Ford during his entire career and has qualified and run both of his cars at the last three national championships. . . . E.A. (Tad) Whited works in ambulatory and occupational medicine and is also medical director of Foundation Health Plan for central Texas. . . . A catch-up note from Bernard Mathaisel, whose career has focused on applying technology to business strategy, first with American Airlines in their advanced technology planning department, then with other airlines, and then on a team working to turn Disney around. He is now with Ernst & Young where he first established a new Center for Business Innovation and later a new practice in Multimedia.—Eleanore Klepser, secretary, 84 Northledge Dr., Snyder, NY 14226-4056; e-mail: <cvsm66@ubvms.cc.buffalo.edu>

67

30th Reunion

Can you believe it? The planning for our 1997 Class Reunion has already begun.

Your assistance is both requested and needed. If you would like to pitch in, contact John Rudy at (508) 440-3768 or <jprudy@swl.msd.ray.com> Let him know what your thoughts are and how you would like to help. Although John and "friends of Rudy" would do a great job, John very much would like a broader and more representative group participating. One proposal is that the reunion be held at a resort. It may be time for that. On the personal side, things are going well for the Rudy family. Brett graduated from Northeastern cum laude and is engaged to be married in March '97. This also means they're down to only one college tuition. John recently took over his Raytheon division's networking (12,000 computers) and desktop NOS, and server applications and mail for all the PCs. It's a challenge and he's learning a lot.

I was tickled to receive e-mail from Ken Ogan, who has moved to Loveland, Colo., to become CTO for Hach Co. Although Hach is a small company, it is a leading player in the

water analysis business, with more than \$110 million in sales. Ken sees tremendous potential for technological development and growth there. Prior to Hach, Ken had been with Hitachi Instruments for six and a half years, where he was principal scientist, and later director of business development when he left. Loree is still in Newtown, Conn., where she has a thriving catering business. This means that she and Ken are doing a commuting marriage, while she works on settling her business situation. They are actually seeing each other more than during the previous two years, due to Ken's heavy travel schedule at Hitachi. Obviously, they are looking forward to being together full-time in Colorado. Their two boys have left the nest—Erik is in Pittsburgh with two years of Carnegie Mellon University under his belt, but he is taking time off and working as webmaster for a financial company. Craig has just started college at Antioch, and is out to revolutionize the world.

Our Class of 1967 Kenneth R. Wadleigh Scholarship Fund supported two students during each of the last two years: Christopher Barnett and Denzil Vaughn. Christopher is from Wichita Falls, Tex., and has completed his junior year in electrical engineering and computer science; musically inclined, he exercises his talents in the Brass Ensemble, the Wind Ensemble, and the Concert Band while also taking private instrumental instruction. Denzil is from Hempstead, N.Y., and has completed his junior year in mechanical engineering. His UROP assignment was in the Newman Laboratories, where he worked on robotics engineering, design, and analysis. His many extracurricular activities include pianist for the Gospel Choir and youth leader for the Community Gospel Chapel.

Ray Ferrara recently changed jobs from chief scientist, data warehousing at SHL Systemhouse to become senior manager in Strategic (system integration) Services at KPMG Peat Marwick. . . . For the last 15 years, Harry Pellow has been running his own business, HCP Research, in Cupertino, Calif. . . . Adam Clayton Powell III, earlier this year moved back to the Arlington, Va., headquarters of The Freedom Foundation, where he is VP for technical programs. As such, his primary responsibility is to extend the technology program to all of the foundation's locations around the U.S. and in other countries. . . . Bill Caton is a neurosurgeon practicing in Pasadena, Calif. He and Cathy have four children—Jenny, 24, a law student; Bill, 21; Adam, 19; and Amy, 14. Last year they hosted the MIT golf team in Southern California.

David Mechler reports that he spent much of 1995 looking for new employment, after getting downsized out the door at Pitney Bowes. He turned an interim consulting assignment into a "permanent" (is there such a term anymore?) position as program manager for new product development at Ascom Hasler Mailing Systems in Shelton, Conn., in December. He likes the international flavor of the job. . . . Glenda and Don Mattes live in a very small village in the Midlands of England, with Derby and Nottingham not too far away. The reason for the move from Dover, Mass., is that Don in January became managing director of Andover Controls Europe Ltd., the parent company of which he helped found and take public in the early '80s. The company has undergone many changes since he left it for

California in 1984. The plan is for Don to run the European division for a couple of years and significantly improve its operations. Don and Glenda are very excited about their European adventure—it's a dream come true. Don's company is located in Ashby-de-la-Zouch, a market town of about 10,000 population. It's beautiful country: green fields, hedgerows, and lots of sheep—and just full of history. Glenda plans to work on her genealogy project, absorb local history, and disconnect from the real estate business for some time. Don and Glenda enjoyed eight days of bicycling in the Loire Valley of France last summer and skiing in Colorado last January.—Charlotte and Jim Swanson, co-secretaries, 878 Hoffman Terr., Los Altos, CA 94024; e-mail: <jswanson@lat.com>

68

Please send news for this column to: Gail and Mike Marcus, class secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818; e-mail: <mrmarcus@fcc.gov> or <ghm@nrc.gov>

69

Since I have been away from this space for some months now (perhaps a bit too involved in the "Cold Fusion War," magazine publishing, and teaching), let me begin with Mark Lively's letter of the month: "For the second issue in a row, I noticed that *Technology Review* had no news about our class. Since nature abhors a vacuum, I decided to tell about my comings and goings. I still live in Gaithersburg, Md., and am still a consulting engineer for electric and natural gas economics. Last spring, I refused to stand for reelection as treasurer of the MIT club of Washington. Seven years was enough. Apparently I wasn't as strong willed as I should have been, since I accepted the nomination to be second VP. However, a benefit of being second VP was attending the MIT Alumni/ae Association Leadership Conference in September. At the conference, I ran into Linda Sharpe. She works for Unisys at the Volpe Transportation Center behind MIT. The one activity that Linda and I had in common was theatre productions. I was in one play our freshman year. Though I remembered her from classes and such—she looks much the same—I couldn't remember working with her at Kresge. Of course, she remembered working with James Woods in various productions, even better than she remembered me. I keep trying to tell my family that I taught James everything he knows about acting, but that I got bored with the concept and quit! Sunday after the conference, I had lunch with Russ Bjork, his wife, Janet, and their son Philip. Russ is now a professor at Gordon College in Beverly, Mass. He started there to get a divinity degree 20 years ago and ended up teaching computer systems. He also has a son and daughter in college. He prefers to affiliate with our class since he started with us as a freshman, even though he managed to get a master's when most of us were getting a bachelor's. In January, I was in Houston on a business trip and saw a brass rat on the rental car shuttle bus. I introduced myself to Chris Ryan. He looked familiar, but

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I am not as thin as I used to be, so I don't think I looked familiar to him. He is now in Pittsburgh. In February I found Hal Varian at UC/Berkeley. I am a specialist in the pricing of electricity and natural gas and was surfing the Internet for papers on the topic. I found his paper on pricing Internet services on a usage basis, saw that he was a classmate, and sent him a note. He responded that I should be ashamed for not attending our reunion. I don't know that shame is the right feeling, though from the comments I have heard about the reunion, regret is an appropriate word."

James Yankaskas writes: "My wife, Bonnie (Simmons '67), and I celebrated our 25th wedding anniversary this year, and the graduations of our daughter Jill from Yale University and of Lynda from Chapel Hill High School. We've adapted well to the 'empty nest' and enjoy more traveling, theater, and music. I remain active at my pastimes of flight instructing and distance running." . . . **Jeff Geier** is with Motorola in Scottsdale, Ariz., working on the design of navigation systems for automotive applications. Both his sons have

"moved on." One is a store manager in Huntington Beach, Calif., and another is a pre-med biology major at UC/San Diego. Jeff's wife, Anne, to whom he has been married for 27 years, is pursuing a master's degree in family counseling at a local college. . . . **Alan Slobodnik** writes, "Through my management consulting work, I have run into a number of Burton House alumni, Paul Demko at Centerline Software and Lou Metzger at Mitre. Speaking of Burton House, Jon Chosiad is assembling a Burton 5 e-mail list. To get on the list, contact him at <jchosiad@itd.ssb.com>."

W. H. Thomas, Jr., tells us that his oldest daughter, Maggie, graduates from Wellesley in June 1996. She became good friends with Heather Kispert, who graduated last year. Heather's father, Bob Kispert, '68, was also an SAE at MIT. "Small world!" . . . **Kathryn K. James** writes, "I seem to be at the stage of my life where I will be chronically unemployed. I lost my job at the end of September, a week after my beloved dog, George, died of cancer. I was re-employed in mid November—and I really hope this job lasts more than six months. I'm almost halfway to my PhD in public administration."

Richard Parker writes, "My wife, Betty, and I have been in Chicago since January (1995), when I started work at the Gas Research Institute. I am enjoying my job, particularly getting back to some basic problems of my field. After 25 years in Texas, I am having some problems getting used to Chicago weather, but living on the lake is very enjoyable, as is being within walking distance of museums, shops, clubs, and restaurants." . . . We hear from **Jeff Passel**: "I've been living in Arlington, Va., for 19 years now. After 15 years with the Census Bureau, I left the federal government to do research at the Urban Institute. I now direct the Institute's Program for Research on Immigration Policy."

James Rhodes sends a brief note: "I'm building computer systems for the semiconductor industry. Lots of travel—this year to Korea and Taiwan." . . . Ending this month's notes on a lofty plane, we hear from **Jerry Raines**: "In my last letter I described the trials and tribulations of obtaining a pilot's license. I am pleased to report that I used that license to fly myself, my sister, and her husband from Gaithersburg, Md., to Hanscom Field (Bedford, Mass.). The occasion was the 1995 MIT family weekend. My nephew is a freshman at MIT, and we all had a fine visit. The plane we flew was a Cessna Skylane, which is a big four-seater, and the flight took a bit less than three hours. The weather was just about perfect, and we had spectacular views of the New York City and Boston skylines. For navigation, we used a portable Global Positioning System, which is about the size of an old HP-35 pocket calculator. How technology has advanced! This little box (a Garmin Model 55) knew our precise position, every waypoint along our route, how far away we were from it, and what changes we needed to stay on course! The flight was an unconditionally positive experience for all three of us. I would invite any classmates in the area who would like to make the trip to contact me. By sharing expenses, the flight is much less expensive and much more convenient than scheduled airlines. Despite what you read in the papers about small planes, they are much safer and more reliable than automobiles on the interstate system."

That's all folks! Those of you who are fully electronic can reach me or submit class notes via e-mail to: <76570.2270@compuserve.com>.—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

70

One of our regular correspondents, **Charles Lieberman**, writes that he has now survived his third merger, this time Chemical Bank with Chase Manhattan Bank. His

new title will be chief economist of the Global Bank, although his job will not change. His oldest son David is now a freshman at Brandeis planning to major in economics; his son Michael will be a senior in high school in the fall; and his son Jeremy will be starting seventh grade. . . . **Dan Paci** is now with the law firm of Power, Bowen & Valimont in Doylestown, Bucks County, Pa., concentrating in tax and corporate law.

Harold Ting continues with his health care management consulting practice. His wife Amy has left the bar code industry to become director of product marketing at MidCom Communications. . . . **James Rothnie** has been appointed senior VP of corporate marketing at EMC Corp. of Hopkinton, Mass., a provider of information storage and retrieval technology. . . . **Wesley Moore** claims that Harvard really knows how to throw a reunion, or at least did for his wife Sandra's 25th Reunion last year. He showed his family the MIT campus and was struck by the difficulty of explaining to current denizens of Connor 5 in Burton House what a "walk-through double" was. . . . Finally, **Alan Chapman** and his wife, Karen Benjamin, added a daughter, Molly, to their family on January 30.

Please send news for this column to: **Karen and Greg Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023; e-mail: <dghbm13d@prodigy.com>

71

Robert Savoy reports a sojourn from applied mathematics at MIT, to vision research at Polaroid Corp., to experimental psychology at Harvard University, to just about anything at The

Rowland Institute for Science, without ever leaving Cambridge. Currently he spends his time in objective introspection: working with researchers at the MGH-NMR Center in Charlestown to take thousands of fMRI pictures of his brain (and those of others) while performing visual, motor, and cognitive tasks. ("fMRI" stands for "functional Magnetic Resonance Imaging," in which traditional MRI pictures are used to detect local changes in blood flow and blood chemistry that reflect local changes in cortical neural activity.) His wife, Deborah Weinstock-Savoy, has volunteered her help and her brain. Hospital rules preclude children of experimenters from volunteering, so, despite their protests, Katherine (11), Rebecca (6), and Nathaniel (2) have not yet been allowed into the magnet (though other children have).

Jonathan Sachs says he is the Jonathan Sachs from MIT who did *not* write LOTUS 1-2-3 and that has given him a lot of spare time. He owns a small design firm in Boston called Centermedia, which creates presenta-

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tions and Web sites. . . . **Tom Milkie** writes: "After 14 years at Northrop, I could see the unfortunate collapse of the California aerospace industry and ventured East for the first time in 20 years. I am now director of engineering at Aurora Flight Sciences, a young company developing unmanned aircraft for environmental research. The company is run by MIT alumni John Langford and many other Tech alumni. Visited **Jim DeLucas** as he is retiring from the Air Force in Plattsburg, N.Y. Jim is an MD and has been fortunate in getting the Air Force to provide facilities, staff, equipment, and clients for his private practice due to the base closure there.

Peter M. Lindner is working for American Express in their risk management group. . . . **Mike Gilmore** is approaching many milestones in 1996, his 25th year since leaving MIT. His oldest stepdaughter, Kim, is graduating from high school (she wants to go to Harvard, if you can believe that), and his daughter Laura is entering first grade. He is enjoying life in Boise as the only male in a house of six. . . . **Peter V. Hwoschinsky** writes: "Beth and I just celebrated our 25th anniversary traveling to Paris and London. Our FAA office of general aviation and vertical flight programs is preparing the Atlanta shorthaul transportation system to provide helicopter transport during the '96 summer Olympics in partnership with NASA and industry. . . . **Lloyd Marks, MD**, is chief of pediatric cardiology at the Children's Hospital of New Jersey. This institution recently opened the largest out-patient health care facility in the State of New Jersey. . . . It is my sad duty to note the death of **David Edmund Hodges**. He was a partner in the firm of Hodges & Shutt in Santa Rosa, Calif.

Also, sadly, **Bob Bendler** died recently. He is survived by his wife, Katherine. Bob was a resident of Burton House during his days at MIT. He was a Course VI major and was employed by Vadem, designing integrated circuits for PC compatible chip sets. Our condolences to his wife and family.—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

72 25th Reunion

Nobody sent any notes this month, but I do have a bit of news. I have spent the winter of 1995-96 in Vail and was lucky to see one of our classmates, **Michael Rowny**, as he passed through town on business. He was in town for some MCI-related business, but we managed to get some great runs in. Unfortunately, I did not get to ski with Melissa and the two girls also, since for spring break they were headed to Utah.

As a class we have previously created the Class of 1972 Scholarship Fund. The 1995-96 recipient of the Scholarship was **Elmer Lee, '96**, a mechanical engineering major from Cherry Hills, N.J. He worked part-time during the school year and full-time during the summer at the MIT Artificial Intelligence Laboratory, doing robotics design. He hopes to go on for a PhD. He was an active member of the Chinese Students Club and enjoys gymnastics, photography, intramural soccer, and ice hockey.

That's all the news for this month. I am returning to Florida after the ski season ends at the start of May, so send your news to me

there. By the time that you read this our 25th Reunion will be less than one year away. Please start planning to be there and, in the meantime, send me your news to share.—Co-secretaries: **Wendy Elaine Erb**, 6001 Pelican Bay Blvd., #1001, Naples, FL 33963; tel: (841) 598-4399; **Dick Fletcher, Jr.**, 135 West St., Braintree, MA 02184; tel: (617) 843-5864; e-mail: <albion.r.fletcher@ccmail.ae.ge.com>

73

Steve Jovanovich writes that he is half-time staff scientist at Lawrence Berkeley National Lab and working half time at the company he founded, Molecular Solution. He's developing a robotic screening solution for bioremediation applications, and still playing soccer and doing T'ai Chi. . . . **Pete Kambour** lives in Lennoxville, Quebec, with Carol and son Nicholas, and is employed at Bishop's University as director of the physical plant. He sends greetings to the old gang from J Entry in MacGregor. . . . **Michael Knauer** has been with Digital Equipment for over 22 years; he's now an IT operations consultant to several of DEC's large customers in the Northeast. He and wife, Kathy, still love living in Burlington, Vt. Daughter Kate (Iowa '97) is a junior, majoring in art. Son Tom is a high school senior and soccer star, and daughter Carrie is a junior and an excellent competitive figure skater at the junior level in New England.

Yours truly was promoted to manager of major programs for the \$2.9 billion Super-Minicomputer Program at PRC, which has now become a division of Litton Industries. This position enhances, rather than diminishes my travel time, so I still spend more time on airplanes than I'd really like, but it helps pay for the hobbies, like feeding and clothing the kids. They're now 22 and 15 (that's 37, Dr. Mattuck). Please note the change in e-mail address and zip code (we have a new area code and zip in the last 12 months and haven't moved in 12 years!).

Please send news for this column to: **Robert M.O. Sutton, Sr.**, secretary, Chapel Hill, 7721 Churchill Ct., Marshall, VA 20115; e-mail: <sutton_bob@prc.com>.

74

Please send news for this column to: Co-secretaries: **David Withee**, 3702 Adams St., Two Rivers, WI 54241-1404; tel: (414) 794-1331; **Barry Nelson**, 65 Hillside Ave., West Newton, MA 02165-2543; e-mail: <barryn@world.std.com>

75

I was asked to fill in for Jennifer this month while she is off fighting patent wars in California. So, I asked those of you on the net to contribute and got a great response.

Suzie and **Thomas Glen Leo** joyously announce the birth of their children born February 10, 1996: Matthew Thomas, Megan Christine, and Melissa Kathryn at Cedars-Sinai Medical Center, Los Angeles. All are doing well, and at 23 days old all are gaining weight fast. Mom is well too. Cruiser, the

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Puzzle

Continued from Page MIT 47

struction of a point X that minimizes the sum S of the lengths AX+BX+CX. Calculate the value of S in terms of the side lengths AB, BC, and CA.

The following solution is from Matthew Fountain:

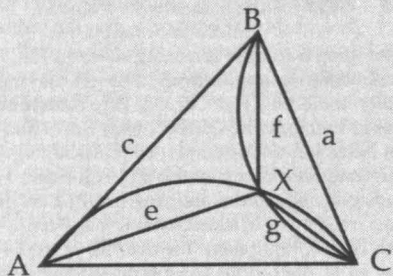
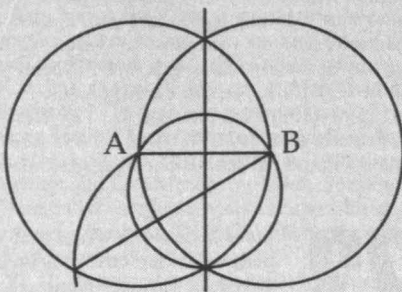
The trivial case is when one angle of the triangle equals or exceeds 120 degrees. Then S equals the sum of the two smaller sides and X is located at the vertex included between these sides.

The following method applies when all angles are less than 120 degrees. Inside the triangle construct two 120-degree arcs of a circle, each on a separate side. Locate X at the point of intersection of these two arcs.

The first figure shows the construction of a 120-degree arc on line AB. The construction is similar to drawing an equilateral triangle with the given line as a side. Perpendicular bisectors to two sides meet at the center of the triangle. When a circle is drawn about this center to circumscribe the triangle, each side subtends an arc of 120 degrees. Two sides of the triangle are not shown in the diagram as they are not needed in the construction.

I conceived this construction by recalling that AX+CX would be constant if X moved on an ellipse in which AX and CX were focal radii and that BX would be minimized when it was a normal to that ellipse. If, for example, BX were not a normal to the ellipse with AX and CX as focal radii, then X can be shifted along the ellipse until it is normal to the ellipse, reducing BX while not changing AX+CX. S is minimal only when AX, BX, and CX is each normal to the ellipse having the other two as focal radii.

As $\cos(120^\circ) = -1/2$, $a^2 = fg + f^2 + g^2$, $b^2 = eg + e^2 + g^2$, $c^2 = ef + e^2 + f^2$, and equation (1), $a^2 + b^2 + c^2 = fg + eg + ef + 2e^2 + 2f^2 + 2g^2$. Taking the area of a triangle as half the product of two sides and the sine of the included angle and $\sin(120^\circ) = \sqrt{3}/2$, the area A of triangle ABC equals $\sqrt{3}/4 (fg + eg + ef)$. Adding $3fg + 3eg + 3ef$ to both sides of equation (1) and taking the square root yields $2(e+f+g) = \sqrt{a^2 + b^2 + c^2 + 3(fg + eg + ef)}$. The area A is also equal to $\sqrt{s(s-a)(s-b)(s-c)}$ where $s = (1/2)(a+b+c)$ so that $3(fg + eg + ef) = 4\sqrt{3}A$. $AX+BX+CX = e+f+g = \sqrt{(a^2 + b^2 + c^2)/2 + 2\sqrt{3} s(s-a)(s-b)(s-c)}$.



FM 3. Warren Himmelberger asks a variation of the birthday problem that he first encountered in *One Hundred Mathematical Curiosities* by William Ransom. What are the odds that (at least) 2 people in a random group of 16 people have birthdays on consecutive days? Now replace 16 by 30.

This problem is harder than it might appear even after you assume 365 days in every year and that 31 Dec and 1 Jan are consecutive. For a group of two people the chances of not having consecutive birthdays is $363/365$ (the second birthday can be in any of the 363 days not consecutive with the first). But for three people it is not $(363/365)(361/365)$ since there are not always 361 days that fail to be consecutive with the first two non-consecutive birthdays (two reasons: the two birthdays could coincide leaving 363 non-consecutive days, and the two birthdays could have just one day between leaving 362). It gets worse for groups of more than 3. Tom Harriman avoided this trap. His solution follows.

Let n = number of persons in the group
 c = number of persons more than one who share a given birthday, aggregated for all shared birthdays
 $b = n - c$ = number of different birthdays

We determine the totality of derangements in which there are no birthdays on consecutive days.

Then each birthday, signified by 1, must be followed by a non-birthday, signified by 0. Hence the 365-day year consists of b elements 10 mixed in with $365 - 2b$ elements 0. For example, one derangement for $n = 4$, $c = 0$ could look like this:

10 10 0 10 0 0 0 0 0 0 0 0 10.

There are $C(365-b, b)$ different combinations of those elements.

When $c > 0$, within any of those combinations the 1 in some of the 10-elements represents two, three, four, or more persons having the same birthday thus differentiating the 10-elements. Therefore there are different arrangements of the 10-elements themselves. For instance, when $n = 16$ and $c = 5$ hence $b = 11$, for the case where three persons have the same birthday, and three other birthdays claim two persons each, there are $C(b, 1)$ elements that could have the one set of triplets, and $C(b-1, 3)$ ways that the other elements could contain the three sets of twins. Thus there are $C(b, 1)C(b-1, 3)$ ways the 10-elements themselves can be arranged.

Further, within any of those arrangements, the first 1 represents the birthday of any one of the n individuals; the second 1, that of any one of the other $n-1$; the third, that of any one of the remaining $n-2$; etc., some 1s representing two or more individuals whose birthdays coincide. As is well known, the number of permutations is $P = 16!/3!2!2!2!$ for the case above.

Finally, the number of derangements for each case is given by the product of the combinations, arrangements, and permutations. The aggregate of the derangements for all pertinent values of c and all significant cases, divided by the number of all possible birthday arrangements, 35^n , gives the derangement probability, p . The probability that consecutive birthdays will happen = $1 - p$.

For $n = 16$, the probability is .5046; for $n = 30$, .9146.

Better Late Than Never

1995 Jul 3. Mihail Ionescu and Lowell Schwartz found more direct solutions.

Other Responders

Responses have also been received from D. Eckhardt, S. Feldman, E. Hume, I. Mazin, K. Rosato, and R. Sinclair.

Proposer's Solution to Speed Problem

The central banks [ed.].

Labrador retriever, is bewildered, however.

Shaman and Glen Speckert's *Dog, Disc, and Wind Web* previews of their upcoming CD made it into the "Top 5 percent of the Web." Short movies and spectacular mosaics reminiscent of Doc Edgerton, '27, await the Web user who can start their exploration of the sport of canine frisbee, previews at: <www.shore.net/~speckert>.

After 12 years at IBM, Elliot Feit resigned last July to accept a position as a statistician at Yankelovich Partners, a market research company in Norwalk, Conn. The job has been a lot of fun and it allows him to use his PhD in statistics full time. He and his family moved

from Poughkeepsie, N.Y., to Stamford, Conn. Elliot's big disappointment is that there are no fast-pitch softball leagues in the area. He was playing softball three nights a week for a long time and is in withdrawal. Wife Claudine has been supervising home renovations and taking care of the kids and would love to get back to work as an electrical engineer soon, possibly part-time. Daughter Chava Simcha (Felice Eve) is about to turn 4 and loves the preschool Yeshiva she attends. Son Zalman Efraim (Saul Anthony) was born on December 31, 1994 (tax break!). He is a lively little guy and gets on great with his big sister.

Alan Razdow writes, "I'm chairman and co-

founder of MathSoft, a math software company (founded in 1985, public in 1992) located in Kendall Square. We went through two years of losses and declining stock prices when we hired a new CEO, Charles (Chuck) Digate. He's done a great job: he started October '94 and we've just posted two consecutive profitable quarters and our stock has risen from \$2 to \$7 per share. We're introducing StudyWorks, a new product for the home education market that includes collaborative capabilities using an Internet connection."

Joe Jones writes, "After getting a master's degree in Course XVI (plasma physics) I worked for three years at the Bates Linear

Accelerator, operated by MIT. Next, I took a year-long, solo trip around the world. Upon returning in 1982, I got another job at MIT, this time on the research staff at the Artificial Intelligence Lab. For nine years I worked on robotic task level planning. In 1989 Sue Stewart, '77, and I were married in the MIT Chapel. Our first child, Katherine, was born in 1990 and our second, Emily, in 1994. During my last year at the AI Lab, Anita Flynn, '83, and I collaborated on a book, *Mobile Robots: Inspiration to Implementation*, which is about to enter its seventh printing. 1991 was an unfortunate year in that I was laid off twice—first from the AI Lab in the great research contraction, then from Denning Mobile Robotics in their nobody-will-buy-our-robots contraction. But like a moth to the flame, I'm working on robots again. I do software engineering at IS Robotics in Somerville, and I also continue developing the educational, small robot kit that accompanies *Mobile Robots*."

Eve J. Higginbotham writes, "Since August 1994, I assumed the position of professor and chair of the Department of Ophthalmology at U/Maryland School of Medicine. I feeling more like an administrator these days than a physician. My husband, Frank Williams, MD, (associate VP for institutional advancement) and I both are enjoying Baltimore."

Todd Moser writes, "Over the last 21 years, I worked as a design engineer at a small cardiology equipment company in Seattle. Then I got the urge to teach after about six years, so I went to U of Illinois/Chicago campus for a doctorate in electrical engineering, getting it in '88. Since then, I have been at Seattle University in the electrical engineering department and got tenure last year. I am married with two kids. I write drama for fun, having gotten a taste for fiction as Baker House secretary. (Not that everything I wrote in the minutes was lies, just most of it.) I'm also doing Windows programming and Web page design. I'd love to hear from Baker House alums from this era, especially Leonard Sherman, Phil Mandel, Bob Fazio, or Paul Davison. I'm at <almoser@seattleu.edu>."

AJ Willmer is the current presiding president of the Beverly Hills School Board and has been a member for the last three years. He runs an independent consulting business specializing in high technology and recently has gotten into Web consulting (along with many of us). He is an avid soccer coach. He has two beautiful girls, Dejah (12) and Anjuli (10). His wife, Debbie Judelson, '73, is president elect of the American Womens' Medical Association and is a practicing cardiologist with the Beverly Hills Cardiology Group. He can be reached at <ajwillmer@ajdj.com>. . . . Michael Wilens has moved to London with his wife and daughter to assume the role of chief executive of LEGION, a UK-based telephone services company with operations worldwide. . . . Bruce Boehm announces that he is moving back to the states from New Zealand.

My brother, David Dinhofer, wanted me to add something about him. He is a radiologist in independent practice in Brooklyn. He has tried very hard to recreate his childhood, although gender reversed, by having had his three children, Max, the oldest, Elka and Chelsea, the twins, in just over a year. This is not quite the same as Thomas Leo above with his triplets. I wish him luck. It will be one hell of a ride.

As some of you already know we have start-

ed an e-mail class list for our class. If you would like to receive class updates by e-mail and meet some of your other classmates in discussion, forward your e-mail address to me. I am looking for help in developing our Web site. You can help by contributing ideas, content, design or graphics. My address is <us002795@interramp.com> or just e-mail directly to the list <mit1975@mitvma.mit.edu>.—Peter Dinhofer (Jennifer Gordon, secretary, 18 Montgomery Pl., Brooklyn, NY 11215)

76

We have word from Jeslie Chermak: "As I write this, it is early morning on December 31—end of an interesting year. It started with the birth, six weeks early, of our first child,

Moriah, 'between the first and second coat' of paint, as we were trying to finish before her arrival. Now, I've yet to finish and its 10 months (and 19 days) later. This was never covered at the 'Tute—I suspect the course has no teachers but "life." . . . From Dianne Glennon: "After receiving an SM from Sloan in '85, worked with Citibank International Technologies Group for the Caribbean, based in Miami. I then went to Citicorp Real Estate to finance construction, again in Miami, was relocated to New York in 1991, and left Citi to finance 'affordable housing' with Dime Savings Bank in 1993. I married Richard Khuzami in 1991."

. . . . Jay Morris: "Still patent counsel at The Foxboro Co.; living in Brookline, Mass. Business is growing for both industrial instruments and systems resulting in a good deal of travel and a fair number of exciting new inventions. Periodically, I run into Brye Davis, '76, who is at our sister company in Rockford, Ill. Jenny Fly, '73 is at GM in New York and drops in occasionally. My wife, Letitia (Harvard GSD '84), is still advancing in biotech research." . . . Michael Bauman: "Still working as an economic consultant at Economists, Inc. Spent part of 1995 involved in television and cable regulatory reform and the rest of the year testifying in an antitrust merger case in Athens, Ga. Looking forward to the reunion." . . . Marsha Lavoie: "Now in my seventh year as a staff physician at a community healthcare center in Worcester, Mass. I also have a faculty appointment at UMass Medical School, as I teach and supervise medical students and family practice residents. As for my personal life, my husband, Jonathan Logee, and I have a 2-year-old daughter. My two sons from my first marriage, Jonathan and Philip, are 13 and 10 now."

From Wendy Peikes: "Wish a warm 'hello' to fellow alum near and far. I'm still in California sharing a house I bought in the Cupertino foothills with two dogs and three roommates. I'm working in the software tools group at Cisco Systems, the leading supplier of Internet working solutions. This is a change from my last jobs working on multimedia authoring tools and performance monitoring as well as the usual software development tools. I spend some of my fun time with alums Jeslie Chermak, Cindy Gilbert '81, and Diane Bracken '75."

Via e-mail, a note from Martha Donahue Callaway, '75, Course XV: "Since going on active duty in the Air Force in 1976, I haven't lived in Milton (Mass.), but get there at least once a year. I married in 1978, traded in my active-duty ID card in 1982 for reserve and

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dependent cards after starting a family. Mike and I have three children—14, 11, and 9—and are enjoying life in suburban D.C. (since 1993, after 11 years in Southern California). I keep busy with Boy Scouts, Girl Scouts, teaching Sunday school, and serving on the PTA. I periodically run into other MIT grads, but seldom those from '76."

As for your secretary, he is preparing these notes just before the start of Passover. I continue to have a frustrating time trying to sell technology (systems solutions) and content (databases and mailing lists we have created). There are days where I am convinced I am the only person left who buys things! On the trading front, I am in the midst of several things, which, should any work out, will be newsworthy enough, perhaps, to include in a future issue. Please remember to stay in touch; without your efforts, we would not have Class Notes!—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523; tel: (516) 295-3632; e-mail: <quantalyt@aol.com>

77 20th Reunion

Please send news for this column to: **Ninamarie Maragioglio**, secretary, 9727 Stipp St., Burke, VA 22105

78 Aaron Endelman writes us from Mountain View, Calif.: "I'm happy to report that after 16 years as an employee, I've become an independent consultant. My corporation,

Elemental Designs, Inc., provides software engineering services to Silicon Valley companies." . . . **Paul Edelman**: "Saw many of my fraternity brothers from Pi Lambda Phi at Brad Morrison's wedding earlier this year. Recently I've been consulting on staffing and organization development with a rapidly growing high-tech company called Micro-E." Paul lives in Lakeville, Mass. . . . **Robert "Mike" Melendez** has joined the OSF/RI and reports that he is very happy to be there. Your class secretary pleads ignorance as to the name for which Mike's employer's acronym stands. We look forward to more correspondence about how Mike is doing in his new job and who exactly his employer is!

John Jaynes sends us news from Grapevine, Tex.: "After many years of planning at American Airlines, I am now managing director of Food and Beverage Services. This means more operational responsibility and a very large budget. I know some of you who have flown recently must find it hard to believe that the airlines still spend money on food, but it adds up quickly! It is ironic that someone who never ate at school in order to participate in lightweight crew now runs one of the biggest food operations in the country." (Your class secretary, having rowed lightweight crew alongside John, does not find it ironic at all!)

And finally a press release: **Colin Adams**, professor of mathematics at Williams College, has been awarded the Deborah and Franklin



however. He is a one-time member of MIT's famed model railroad club who still works on a train display in his own basement (above), and his experience helped Weiss to design Aerotrak, an overhead monorail sys-

tem that moves silicon wafers through the manufacturing process. Semiconductor manufacturers estimate that silicon wafers go through 400 process steps—six miles of transport in a typical factory—in their journey to become computer chips. Aerotrak consists of an aluminum track equipped with "intelligent" cars (shown below) that read electrical impulses to determine where each cassette of wafers should go. The system also uses turntables, switches, and mini-elevators to move cars between floors. System users include Intel, Motorola, and Samsung, and Aerotrak was rated one of *Industry Week's* 50 Technologies of the Year.

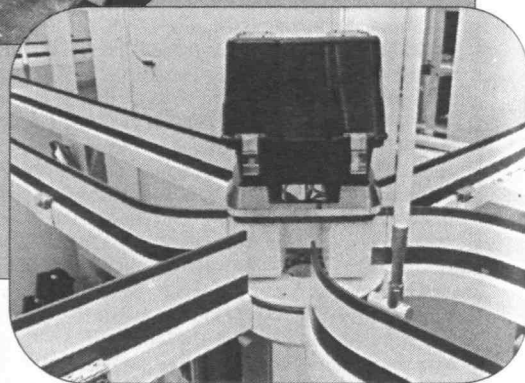
Tepper Haimo Award for Distinguished Teaching of Mathematics. The award is given by the Northeast Section Mathematical Association of America. It honors college teachers "who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had an influence beyond their own institutions." Colin specializes in topology, the study of those properties of geometric figures that remain unchanged even when under distortion. He has written a number of articles on the mathematical significance of knots, and his 1994 book, *The Knot Book*, explains some of the more complex knot theories in accessible terms. His work with knot theory has applications in DNA research and synthetic chemistry.

Colin is well known for playing the character of Mel Slugbate, a sleazy real estate agent in a green polyester suit, who, in his attempts to sell houses, presents mathematical concepts to the audience. At Williams since 1985, Colin has also taught at Oregon State, UC/Santa Barbara, and UC/San Diego. He got a PhD in mathematics in 1983 from University of Wisconsin at Madison.

Meanwhile, your class secretary and wife **Diane Curtis** find the real estate business (sans green polyester suits) to be flourishing. Our children have expressed great interest in growing food in the (organic) garden this year. We are looking forward to starting homeschooling with them this fall. (Any other homeschoolers out there?)—**Jim Bidigare**, secretary, 9095 North Street Rd. NW, Newark, OH 43055-9538; tel: (614) 745-2676; fax: (614) 745-5648

tem that moves silicon wafers through the manufacturing process. Semiconductor manufacturers estimate that silicon wafers go through 400 process steps—six miles of transport in a typical factory—in their journey to become computer chips. Aerotrak consists of an aluminum track equipped with "intelligent" cars (shown below) that read electrical impulses to determine where each cassette of wafers should go.

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79 Marla Eglowstein has just experienced her 15 minutes of fame and then some. She was the obstetrician who delivered the famed Haner sextuplets who were born on March 22 in Albany, N.Y. Three days after the birth, Marla described the experience thus: "There were four boys and two girls, weighing between 2 lbs. 1 oz. and 2 lbs. 9 oz.; all are in NICU and doing great. Mom had a c-section at 28 weeks of pregnancy after having preterm labor. We had originally thought there were five babies, but in the last two weeks, we started seeing too many arms and legs—then it became clear that there really were six of them. I had assistance from three of my colleagues, two scrub techs, three OB nurses, four anesthesia people, and six teams for the babies, which consisted of a neonatologist, nurse, and respiratory therapist for each one. As I took out each baby, I passed him or her to one of the other OBs, who cleared the baby's airway then passed it along to the other two OBs, who cut the cords and handed them off to the pediatric teams. We have had a LOT of media attention. There was a press conference that day, and several sets of interviews with networks, particularly ABC. We will be on *Turning Point* in early May. (I was interviewed by Diane Sawyer for that one.) Today,

the parents were on all three of the morning shows (*Today*, *Good Morning America*, and *CBS This Morning*), and I joined them on *Good Morning America*, where we were interviewed by Joan Lunden. It has to be the most exciting delivery I've ever done, by far. I have been in solo practice for the last 18 months, but will have associates very soon. Meanwhile, my family is great. My husband, Eliot, is still in the Information Science PhD program at SUNY/Albany. My son, Nate (age 7), is in first grade, where when he was asked to choose an animal to write a report and do a diorama about, he chose plankton. He definitely could move right into 7.01 at this point. He cut out about a dozen tiny little pieces of paper and hung them in his shoebox, painted with metallic paint to look like ocean water, and it was terrific. My daughter, Davi, is now 2, and very adventurous. Since she is also an ultimate charm queen, she gets away with everything. She is definitely showing flashes of math ability (knows how to count to 20, sort of)."

I am pleased to tell you of the three students that received funds from the Class of 1979 Student Aid Fund during the last academic year. Nicole Lee, a sophomore majoring in biology, plans to make a career in medicine. She is also a dorm officer and a member of numerous student groups. She has a scholarship from the music department to do private study and plays with the Chamber Music Society. Joseph Siddiqui graduated in June with a major in mathematics and a 4.7 GPA. He hopes to get a PhD in math and work in academia. He was a math department tutor and recitation instructor. Steven Brunelli, another senior with a 4.7 GPA, is a chemistry major planning on a career in medicine. His recent UROP explored new methods for the synthesis of Beta-lactones and their subsequent conversion to Alkylidene-cyclopropanes. He worked as a chemistry teaching assistant and was also an active athlete.

Your faithful secretary's directorial debut last month was a smash success. I am also making my professional singing debut tomorrow night as a member of a chamber music choir. Next month, I am going to resume my Italian language studies. Please write and let me know what you have been up to for the last 17 years.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374; e-mail: <clowens1@pfizer.com>

80 Hope your summer has started off well. How about a little contest to get you writing? Send your news on a postcard from your favorite vacation spot. I will report your news and pick winners in the following categories: funniest postcard, most picturesque postcard, postcard of the greatest distance (from Detroit), and most original.

Just a few notes this month. **Chip Saltsman**, his wife, Ellen, and their three children (Jennette, 10, Emily, 8, and Kyle, 4) are living in Maryland. Chip is national director of campus recruiting for Ernst and Young's management consulting practice. This keeps him on the go to campuses across the country, including the newly remodeled MIT interview facilities. Chip writes, "In my spare time (ha, ha), I try to keep up with the entropy of an old house."

Thomas Russ is settling into the family life.

His second son, James, was born a day before Halloween—his wife insisted they would not have a Halloween baby! . . . **Timothy Folster** is still working for H.E. Sargent, Inc., in Stillwater, Maine. He is in charge of the earth-work division, which concentrates in environmental work. . . . You can reach **Kathleen Leitemann** at her e-mail address: <kleitemann@genetics.com>. She writes that she is still having fun at Genetics Institute.

Send your news and postcards to: **Kim Zaugg**, secretary, 549 Fairfield Rd., Canton, MI 48188; tel: (313) 981-1785; e-mail: <vayda@erim.org>.

81 Please send news for this column to: **Mike Gerardi**, secretary, 412 N. Oakhurst Dr., #202, Beverly Hills, CA 90210; tel: (310) 203-8080 (w); e-mail: <mimg@jmbm.com>

82 **15th Reunion**

Daniel Maserang left General Dynamics recently when the Space Systems Division was sold to Lockheed-Martin. He got a seat in launch control for launches due to his position as launch vehicle-satellite integrator. His satellites are used to broadcast HBO/CNN/ESPN and PBS. Daniel has a new job in project evaluation for an electric utility. . . . **Daniel Metzger** is back in Wichita doing stress analysis for Cessna Aircraft. He and his wife, Nancy, have three children, two girls and a boy, ages 6, 3, and 1. He is also an ordained Lutheran pastor and preaches frequently in area churches. . . . Since graduation, **Sally Barros** has lived in Central America working as a journalist and part-time statistics professor at the University of Managua and lived in San Francisco waitressing and taking ballet classes. After attending grad school in Berkeley, she married, moved to Sweden, had two kids, and now lives in Chili working as a journalist and raising her kids.

Send notes to **Helen (Fray) Fanucci**, secretary, 502 Valley Forge Way, Campbell, CA 95008; e-mail: <fangroup@aol.com>

83 A few people wrote in this month. **David Shumway** graduated from the Univ. of Chicago Graduate School of Business, with an MBA in June 1995. David now works as a financial analyst for United Airlines. . . . **Ivan Fong** works as a partner in the Washington, D.C., law firm of Covington & Burling. Ivan was recently selected to serve on the Stanford University board of trustees. Ivan, his wife, Sharon, and three young children (Kelly, 8; Caitlin, 3; and Caroline, 1) all live in Bethesda, Md. . . . **Melissa Miller Pimenta** had a baby boy, Bito, born February 7, 1996. Bito joins sister Christina, who is 21 months old. Melissa and her husband have their own business.

Bryan Liang writes that after graduating from MIT, he has been on the educational trail obtaining a PhD in health policy from the Univ. of Chicago, an MD from Columbia, and a JD from Harvard. Brian is now an assistant professor of law at Pepperdine University

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School of Law in sunny Malibu, Calif. . . . **Mike Thompson**, still with Keane, Inc., a consulting/software services company, was recently promoted to senior consultant. He is working on an expert system for monitoring and assisting in the isolation and correction of faults for telephone switches. He reports that he has had an aggressive project schedule, two very active daughters (4 and 2 years old), and a wife who is trying to keep a master's in nursing thesis on track for a spring 1996 graduation.

Please keep those cards, letters, faxes, and e-mail coming!—**Jonathan M. Goldstein**, secretary, c/o TA Associates, High Street Tower, 125 High St., Suite 2500, Boston, MA 02110; fax: (617) 574-6728; e-mail: <jgoldstein@ta.com>

84

Please send news for this column to: **Jonathan Miller**, secretary, 1708 Plaza Ct., Mountain View, CA 94040; tel: (415) 813-1100 (w), (415) 961-2394 (h); e-mail:

<jonathan_miller@logitech.com>

85

Please send news for this column to: **Bill Messner**, secretary, 5407 Pocusset St., Pittsburgh, PA 15232; tel: (412) 421-4334; e-mail: <bmessner@cmu.edu>

86

As of the time you are reading the print edition, our 10th Reunion will be a set of fond memories. Thanks to all who made it back, and particular thanks to Reunion Co-chairs

Kim Hunter and **Lisa Mitchell** for the time and energy they put

into making it a special occasion for all.

Joy Hussain is doing a residency in family medicine in Seattle, Wash., and is "loving every minute of it!" She still sees a lot of **Marian Sackler**, who is doing a rheumatology fellowship in Dallas, Texas. Joy writes that she is contemplating the idea of getting married and moving to Australia next year. . . . **Alan Sayre** has joined Babcock and Wilcox's Alliance Research Center in Ohio as a research engineer III in the Combustion Technology Section. He was previously at the International Flame Research Foundation, and is active in the American Institute of Chemical Engineers and the Combustion Institute.

Anna-Lisa Fear and her husband, John Goodwin, are enjoying their son, William, now well 6 six months old. Anna-Lisa is still working at Chiron Corp. in Emeryville, Calif., and has enjoyed getting together with both of her old housemates, Paul Manske, '85, and (Scheidler) Winner, '85, both of whom are now living in the South Bay area. . . . **Jerrard Sheehan** started a new job in the fall with the Computer Science and Telecommunications Board of the National Research Council. . . . **Lars Bessolka** works for CS First Boston and has spent the last six years in Singapore. He is in the project finance group, working on projects throughout Asia. He expects to move to Hong Kong sometime in '96. . . . **Elisa (Barzelay) Collins** writes from St. Paul, Minn., that she and her husband, **David Collins**, celebrated their 10th wedding anniversary in May. Both are working for 3M. Their baby, Steven Bradley Collins, was born on May 24, 1995.

Noel Zamot sends greetings from the Mojave Desert. He and his wife, Diane, were graced by the birth of their first son, Noel Sebastian Zamot, in September 1995. "If anyone out there is thinking of having a child, may I emphatically recommend an unmedicated birth. It is amazing what a mother's body does to give birth to a perfectly healthy baby."

He is still at Edwards Air Force Base flying the B-2. **Jim Wilkerson** was out at Edwards once in '95, flying tankers in support of their test program. Noel tried to refuel his B-2 behind Jim's KC-135 (an MIT '86 reunion of sorts over the Mojave Desert), but alas, it did not happen. Noel reports that **Rich Maurer** brought a B-1B down to give rides to the students at Test Pilot School, and "in five days I managed to miss him four times." Some other recent highlights from Noel include presenting results from his sonic boom study at the American Aeroacoustical Society symposium in Washington, D.C., getting to interview for the NASA Astronaut program in Houston (very extensive screening process, good luck!), and getting to telemark ski for the first time, where Noel encountered blizzard conditions on the last run of the last day. We'll let Noel tell you the whole story in person.

Scott Musinski is a faculty member at the University of Tennessee/Memphis in the Department of Family Practice. . . . **Megan Smith** moved up to San Francisco after spending five years in Silicon Valley. "The city is great. I live with Emma Bufton, from Western England, and we've been together for over three years." Megan has been working at General Magic, a small communications software company, since 1990 when it was founded. She manages part of their business and partnerships in Europe and travels quite a bit. . . . **Mary Engebret** is enjoying her position as a professional staffer with the House of Representatives Committee on Intelligence, where she also gets to work on oversight of the National Reconnaissance Office. "On a lighter note, the kids are getting big (Jerad is 2 1/2 and Jordan is 15 months)." Mary and her husband, Erik, recently took their family to Vail with us for a week of skiing along with some of Erik's Stanford friends. "Jerad will be old enough for ski school next year. That'll be just about the time we start considering migrating

At first we thought it was a hack when we received the following news for Class Notes from Steve Altes, '84, but further investigation and a recent article in the Washington Post affirmed that Steve's real life indeed reads much like a fairy tale.

He writes: "My life has pretty much turned into

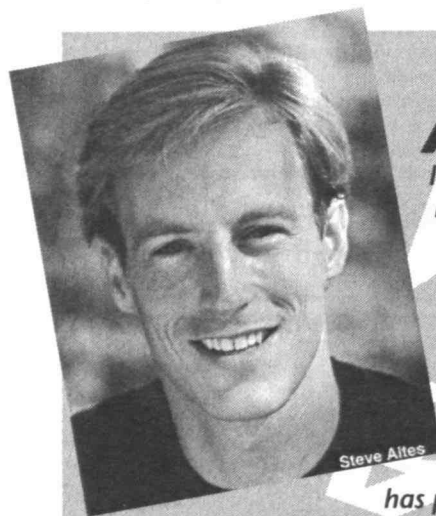
a fantasy. I'm acting now in movies, TV shows, and soap operas. GQ has asked me to model for them. The FBI hires me to play criminals for their new agents to try to catch. St. Martin's Press just bought my first book (humorous observations about business). And, I'm being considered for the lead role in a movie starring Josie Bissett, of Melrose Place. I am about to produce in Moscow, Russia, a play I wrote. Oh yeah, and I'm dating a real, live baroness

with castles in Belgium. (I don't blame you for not believing me, but every word is true.) We are going to spend a month in Tahiti soon."

And he even left out a few things. The Post reports that this used-to-be rocket scientist acts, models, and stands in for superstar Brad Pitt. "I have been his hand photo-double, doing things like cocking guns and slamming car trunks," says Altes. "I am not his butt-double or his ab-double. He doesn't need one."

It was the part about winning the National Medal of Technology in 1990 (the nation's highest award for engineering achievement) that made me skeptical, so I called Altes. "And just who gave you this medal?" I asked. "George Bush," he replied. "And where was that?" I asked, sure that the game was up. At the White House, of course. More details: he was corecipient with 11 others. It was for a NASA design for the world's first privately developed space-launch vehicle, Pegasus.

After winning this award, Steve realized he had to leave technology for new vistas. And he adds: "I encourage everyone to follow their passions. It is the only way to live!"—**SANDRA KNIGHT**



west to the Rockies." In other news, Mary reports that **Karen (Wohl) Schmitt** and her husband, **Ray Schmitt**, recently had a little girl, **Kelsey Irene**, in February.

Wade T. Shimoda is still living in beautiful Middlebury, Vt., with his wife, **Lori**, and their cats, **chinchillas**, and **tropical fish**, and he's still working for **Central Vermont Public Service Corp.** "The winter has been great for winter sports, but it's getting old and I'd like to ride my bikes again." . . . **Erik J. Rothfus** reports that he has recently rejoined **DAZEL Corp.**, a spin-off from **Tivoli Systems**, as VP for Internet initiatives. He is also doing research at the University of Texas, working with **Cornell** physicists developing software for collection of events from the **CLEO** experiment at **Cornell's** Electron Storage Ring accelerator facility. **Erik** and his wife, **Lisa Wellons (Simmons '85)** had their first son, **Joshua James**, born January 12. "Mom and baby are doing fine, and Josh has already gained 5 lbs. from his whopping 8 lb. birth weight." They were planning to attend **Mark Caylor's** wedding at the end of March.

Lee Newberg writing from Illinois proudly announces the arrival of his baby daughter, **Margaret**, born September 21, 1995, to **Lee** and wife **Heidi**. Baby pictures are available on the WWW at: <<http://http.bsd.uchicago.edu/~l-newberg/pictures/>>. . . **Joe Megna** is still involved as president and founder of the **Hawaii Alpha Chapter (University of Hawaii)** of **Sigma Phi Epsilon**. Other fraternity brothers currently living in Hawaii and involved are **Dan Curran**, '85, **Roger Horton**, '90 and **Dave Brown**, '87. His professional time is involved as an equity participant in start-up companies. One of his first projects, **C-ATS Software**, just went public under the symbol **CATX**. "Anyone wishing to spend a day sailing and see the Hawaiian islands is welcome to visit...my home is still a 350-day sloop."

Two important last notes regarding the electronic version of **Class Notes**. First, if you would like to be added to our class e-mail list, or would like to change your existing e-mail address on record at MIT, please send e-mail directly to: <mitalum@mitvmc.mit.edu>. Second, for all of your information, the **Class Notes** mail list is a "moderated" list. Your submissions are directed first to the class secretary, who then compiles and edits all submissions before the **Class Notes** column is sent to **Tech Review** and to everyone on the list. Any commercial advertisements are NOT passed on to the alumni/ae on the mail list, so we ask that readers please refrain from sending solicitations to the class e-mail address. To submit news items to **Class Notes**, please write to: **Bill Hobbib**, 5 Cappy Cir., West Newton, MA 02165; e-mail: <mit1986@mitvma.mit.edu>.

87

10th Reunion

This year's recipient of the Class of '87 Student Aid Scholarship, **Aaron Maldonado**, '98,

is a sophomore who recently declared electrical engineering and computer science (Course VI-2) as his major. Aaron centers his extracurricular activities around the MIT Gospel Choir, and performs both at the Institute and in area churches. He is also involved in intramural sports, especially tennis (tournament level), ice

skating, and journalism. Tuition has certainly not gotten any lower since we were students, and your continued generosity will enable us to support other students like Aaron in future years. Keep up the good work!

Since graduation, **Duncan McCallum** has stuck around the Boston area, first earning a master's from MIT, and then continuing to work at **Draper Labs** as a senior engineer and program manager. He then went to **Harvard Business School**, and finished in 1994. After being assistant to the president at **Haemonetics Medical Devices**, he is now at **OneLiberty Ventures**, a venture capital firm in Boston that focuses on early-stage companies. He's especially excited about the possibility of working with some of our entrepreneurial classmates! In 1993, Duncan married **Joy McIntyre (UVM '88)**; she expects to finish an MS in nutrition this year.

Duncan fills us in on the whereabouts of his brothers from FIJI: **Rich Rice**, '88, is currently living in California and working in the restaurant industry. . . . **Gordy Holterman**, '86, got a law degree from Stanford and now runs a Bay Area sales office for **Swiss Bank**. He is married, with one child. . . . **George Zachary** was director of consumer marketing for **SGI**, but just left to join a venture capital firm in California. . . . **Auggie Peccei** is a trader in San Francisco, and is engaged. . . . **Dave Solo** is on the board of directors of **Swiss Bank**. . . . **Glenn Hopkins**, '88, lives in Boston, and is a partner at **J.W. Childs and Associates**, a LBO firm. . . . **Bob Joy** is a physician with the U.S. Army. He's married and has a couple of kids. . . . **Art Gregory** is an engineer with **Cobe Labs** in Colorado. . . . **Brett Giles** is married, lives in Indiana, and works for **GE**.

Grace Ueng Trombetta and her husband, **Patrick**, have settled back in the Twin Cities. She is working for **MECC**, a children's educational software publisher is in the process of being acquired by **Softkey International**. The combined companies will be the largest publisher of educational software. Grace reports that one of her products, **Oregon Trail II**, was awarded a **Software Publishers Association "CODIE"** Award. She was invited to demo the product at the **Microsoft Windows 95** launch in Redmond, Wash. Some events coming up for Grace include her 5th year reunion at the **Harvard Business School**, golf in **Sedona**, and hiking the **Grand Canyon**.

Christine "Dorn" Kehrley is living in Germany (near **Kaiserslautern**) and working as an international tour organizer and guide (especially in France). She loves living and traveling in Europe. . . . **Captain Andrew Thurling** is an F-15 fighter pilot, and recently moved from **Elmendorf Air Force Base**, Alaska, to **Langley AFB** in Virginia. . . . **Mark Hickman** is currently a postdoc at the **UC/Berkeley**. His research is in the **Institute of Transportation Studies**, where he is examining the application of new technologies to solve transportation problems. **Mark** and **Sherry Harysch** had a Leap Baby! **Michael Levi Staley Harysch** was born on February 29, and weighed in at 8 lbs. 3 oz. **Mark** is currently based at the **Air Force Academy** in Colorado.

Guess what! It's almost time for our 10th Reunion! I am currently planning a trip to the Institute to attend their reunion kick-off meeting on April 10 (this is being written in mid-March). As the meeting is being held on a Wednesday, I have made arrangements to be in Boston for that day only—a neat trick given

GAZETTE

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that I cannot skip out on any of my Tuesday or Thursday classes. All I can say is thank goodness for **Frequent Flyer Points** and **ValuJet**! Please let me know if any of you are interested in serving on the reunion committee.

If you would like to find out more details about the whereabouts and doings of your classmates, you can check out the MIT listing of alumni/ae home pages on the **World Wide Web**. They are listed by class at <<http://web.mit.edu/alum/www/Homeworks/class/>>; however, according to **Mark Wang** (who filled me in on this), there are not too many '87ers listed there yet. If you have a home page and would like to be listed and linked on the MIT site, please let me know and I will make sure it is done. By the way, I am just about to break ground on the MIT1987 Web site. It will be a good place to go for reunion information, back issues of these columns, as well as links to individual home pages. I will send more information out about that as soon it is ready. 'Til next month.—**Jack Leifer**, secretary, 2908 Roses Run, Aiken, SC 29803; tel: (803) 642-3900; e-mail: <leifer@sc.edu>; <mit1987@mitvma.mit.edu>

88

Tara Brown works in medical architecture in Phoenix and teaches sophomore design at **Arizona State University**. She is engaged to marry **Bryan C. Mccay**, '89. . . . **John Kuenz**

recently sold his first company to **Teradyne** in Boston and is in the process of trying to start a second (hopefully also successful) company in the Internet marketplace. He and **Sonia Leon Kuenzig**, '87, recently visited **Farzad Ehsani** in



Wedding of Doris Lin, '89, and Daniel Kim, '78 ~ MIT alums in attendance included (l to r): Joanna Hoffman, '77; Grace (Napier) Monnen, '78; Jennifer (McKenney) Lopez, '90; Jose Lopez, PhD '65; the groom; Chong-jin Lee, SM '61, PhD '65; the bride; Bruce Larson, '89; Kim Stopak, '89; Diana Marmorstein, '92; and David Jacobs, '80 (not pictured). Bruce and Jenny were in the wedding party. (photo: David Gordon Photography)

California, who is doing well and is currently working at Lexicus Corp.

Ronald Carino is graduating with a PhD in chemistry from Univ. of Wisconsin. He plans to take a postdoctoral position in Madison until his wife graduates. Ronald and Susan Hawley (Oberlin '90) were married in June 1995. At the wedding they saw Jim Koonmen, '89, Debbie Nungester, '89, Paul Wang, and Arin Ram, '87. . . . Arlene (Shames) Bernhardt and husband Marc had a son, Joel Matthew, last August 15. They also purchased a house and have spent the last year cleaning, doing yard work, painting, and lots of snow shoveling. Still they are enjoying parenthood and home ownership immensely.

Jaimie Morgan, an MIT sophomore from Ghent, Ky., has been chosen as this year's Class of '88 Scholarship recipient. Jaimie is a management major and is doing very well academically. Her campus activities include: singing in the Muses (an all female capella group), playing ice hockey, helping with sorority projects, and working part-time. Thanks to all who contributed to the fund.

Please send news for this to: Catherine Suri-ano Singer, secretary, 131 Main St., Andover, MA 01810-3804; email: <singer@mit.edu>

89

This month's list of people to please send news is: Cory Arnold, Dean Fiala, Kia Freeman, Zsuzsanna Gaspar, Kevin Moschetti, and Michael Williamson. What are y'all up

to? If anyone knows about any of these people or anyone else, please write in.

In February, Kriztina Holly's company, Stylus Innovation (the developer of Visual Voice, Visual Fax, and Otto, a LAN-based auto-attendant, call control, and voice messaging system), was acquired by Artisoft, Inc., in a cash transaction valued at approximately \$12.8 million. In 1991, Kriztina's team won the \$10,000 first prize in MIT's 10K Competition. Stylus incorporated in 1992 and signed a \$7.9 million manufacturing and distribution

license for its first product, the Stylus Barcode/Response Unit, with the largest independent distributor of VeriFone equipment. Late in 1993, Stylus launched Visual Voice, which rapidly became the leading Windows telephony development tool in the industry. Stylus' customers include Fortune 500 companies such as Boeing, Cigna, DEC, Merck, NBC, Sony, US Air, Xerox and more than 25 percent of the Fortune 1000. Krisztina is co-author of the best-selling book *Visual Basic Telephony*.

A few weddings to report: John Krusac is marrying Jacki Hennessey (Wellesley '89) this spring. . . . Steve Betz is getting married this spring in Indiana. . . . Doris Lin is in her third year of law school at USC. Doris and Dan Kim, '78, were married on May 20, 1995 (see photo). The wedding was in New York City, at the United Nations Chapel, and the reception was held at the Anti-Defamation League. Doris writes that "The reception was totally vegan—no meat, eggs, or dairy."

Doris also writes that Nat Seymour recently moved to LA where Dan, Doris, Nat, Paul Cavanaugh, and Ted Pascaru recently went out comedy clubbing. Nat and Karl Dishaw were among Doris and Dan's guests for a vegan Thanksgiving dinner (though Nat supplied a turkey for the die-hard meat eaters). Recently, Doris has been working as a volunteer for the "No on 197" campaign, an effort to defeat the NRA's attempt to legalize the trophy hunting of mountain lions in California.

Peter Kofinas has been at MIT ever since finishing his SB, having received a master's in chemical engineering practice in 1989 and a PhD in materials science and engineering in June of 1994. Peter is now a postdoctoral research associate in the Department of Chemical Engineering, and has accepted a faculty position at the University of Maryland at College Park starting in August of this year. Peter will be an assistant professor in the Materials and Nuclear Engineering Department and will also be an affiliate assistant professor in the Chemical Engineering Department.

Laura Brauer reports: "Work at Lockheed

Martin Astro Space has been really hectic. They announced the closure of our plant for the first quarter of 1998. I've gotten an offer to move to Sunnyvale, Calif., at that time but am undecided as to whether I will accept or not. Since I have about two years before I lose my job, I haven't really been motivated to find another one either. The attrition rate here is incredible. As people leave, the work load for the rest of us increases. In 1995 I had a two-week trip to Xichang, China, in May, a two-week trip to Cape Canaveral in July, a three-week trip to Kourou, French Guiana, in August/September, a five-week trip to Xichang, China, in October/November and a two-week trip to Cape Canaveral in December. These trips were all to support launch site testing for various satellites. China was really interesting, but the second trip was too long. My favorite launch site is in Kourou, French Guiana. That was my eighth trip there in six years. This time, we had a free weekend, so a couple of us took a trip up the Approuague River and camped for two days in the jungle. It was really cool laying in a hammock listening to the jungle sounds all around us."

Laura also writes that Marlene (Lamas) Cullum and her husband, Mal, had a baby, Elizabeth Claire, on December 19, 1995. "Older sister, Emily, was a little jealous at first, but now she adores her baby sister." Laura visited the Cullums in January. Laura continues: "If anybody hears of any job openings for a mechanical engineer with manufacturing experience, let me know." . . . Susan Streisand and husband, Steven Zweig, announce the birth of their first child, Leah Streisand Zweig, on January 25, 1996, weighing 8 lbs., 6 oz. Susan writes, "She is already learning to surf the Internet." . . . Salma Saeed, who is in the Mechanical Engineering Department at Stanford, defended her thesis on May 15.

Livia Racz started as an assistant professor at Tufts in January. Livia teaches in the areas of thermal-fluid sciences and transport phenomena in materials processing. Her research deals with understanding the effects of surface and body forces during materials engineering and manufacturing processes. . . . Rob Lohr and wife Lola (Matysiak), '91, recently moved out to Colorado, where Rob is working for Price-Waterhouse, and Lola has joined Oracle Consulting's Telecomm group in the Denver office. Lola just finished the five-week custom development boot camp in Bethesda, Md., and is looking forward to her first assignment, probably at Sprint in Kansas City, Mo.

Well, that's it again for this month. More members of the class have home pages, so be sure to check out the '89 home page at <<http://www.tns.lcs.mit.edu/mit89/>> and send your URL if you have some info. Please send in news!—Henry Houh, secretary, 4 Ames St., Cambridge, MA 02142; tel: (617) 225-6680; fax: (617) 253-2673; e-mail: <hnh@mit.edu> or <henry_houh@mit.edu>

90

Let's kick this column off with news from the sports teams. Swimmer and water polo player extraordinaire Mark Edelson reports that he spent the last year in the Greek

island of Crete managing construction projects for the U.S. Navy. In March '96 he returned to San Diego to work for the Marine Corps and

to continue competing in triathlons. . . . **Shane LaHousse** (football) wants to wish the MIT football coach luck with the recruiting season. . . . **Mark Hickman**, '87, swimmer and Bakerite, writes with the following news: "I am in the Bay Area; I am doing a postdoc at UC/Berkeley in civil engineering. I have also managed to keep swimming; I now swim for a master's team here in the East Bay. I was happy to see your report on **Andrew "Tippy" Knoedler** and **Penn Loh** in the April '96 of *Tech Review*. I am glad to hear that other swimmers have found life after MIT!" We wish you luck as you pursue the PhD.

Someone who doesn't need our luck chasing that degree is class treasurer **Charrissa Lin**. Read for yourself! "I've finished my PhD! Yay! I defended on January 16 and turned in the final document on the 31st of January. I haven't fully figured out what my next step is—I'm considering a few offers. Right now I'm working as a post-doc for my advisor to tie up some loose ends until June (graduation ceremony time). I'm taking the summer off—last summer vacation for awhile—and I plan to start a job in the September time frame. I'm planning on doing some traveling this summer. My sister and I are going to do a bike trip in France and I will be road tripping down to the Olympics with a friend. I'm totally psyched!"

Congratulations to fellow Stanford Law students **Erica Kuo** and **Bart Giddings**, PhD, '94, who are the regional winners of the **Giles Rich Moot Court Competition**. Bart and Erica went on to the National Finals on April 10-12 in Washington, D.C. . . . **Beth Kulas** is at Duke working toward a PhD in economics and reports: "Will probably defend my prospectus in a month or so. Been swimming pretty hard. I am up to 3,000 yards now. I am pretty happy with that distance. Now to get faster."

I had the pleasure of a visit from Ross (yes, you CAN call me doctor) **Levinsky**, '89, PhD '94, at the beginning of March. He was here for a week-long junket, tacitly exploring the job market but really just hangin' with his old homies. Among those lucky enough to see Ross were, **Alissa Fitzgerald**, **Andrzej Skoskiewicz**, **Armando Fox**, and **Alisa Mosler**, '91. There were others and I apologize for not being complete. **Alissa**, **Kortney Leabourne**, '92, **Mike O'Connor**, '92, **Christine Harada**, '94, and **George Pappas**, '88, all here at Stanford, and I are headed to Maui for spring break. I'm hoping we had a good time! Tell you what. If you're getting tired of hearing about swimmers, Bakerites, and Stanford folks send in some of YOUR tidbits. I'm looking to set new records in column-inches printed and I need your help! I want to hear from folks on the crew and squash teams, and from all the ILG's. Get off your duffs, dust off that keyboard and send me an update!—**Max Ochoa**, secretary, 10726 Red Arrow Hwy., Bridgman, MI 49106; tel: (616) 465-3257; email: <mochoa@leland.stanford.edu>; <mit1990@mitvma.mit.edu>

91

Peter Sparks is studying for a master's in computer science at the University of Washington in Seattle. He was recently engaged to **Masako Ikegaki** (Wellesley '92). . . . **Mark Stammering**

served a mission in Germany for two years for the Church of Jesus Christ of Latter-Day Saints. He is now working on telecommunications publications near Washington, D.C. . . .

In spite of the efforts on her behalf by Congressman **Joseph Kennedy** (D-Mass.), Senator **Alfonse D'Amato** (R-N.Y.), and others in Washington, **LORI BERENSON**, '91, remains imprisoned in Peru as an alleged leader of a violent rebel organization and arms trader. "The charges are complicated and change day by day," says her U.S. lawyer, **Thomas Nooter**. "She has not been able to speak with anyone uncensored. Charges that were never addressed by the prosecutor were brought up in court. No opportunity for witnesses, no forensic evidence." **Berenson** left MIT after three semesters to study first-hand the political and human rights situation in a number of South and Central American countries. She was first arrested by the Peruvian mil-

itary police on November 30th of last year, and in January 1996 she was sentenced to life in prison without parole in a military trial that flagrantly violated Peruvian law. In April, her parents, along with MIT anthropology professor **Martin Diskin** (with whom **Berenson** did a UROP project) and others, held a public forum on the MIT campus to enlist support in putting pressure on the government of Peruvian President **Alberto Fujimori** to remand her case from a military to a civilian court. Meanwhile, they report, **Berenson** remains in a mountain prison without heat, hot water, or a regular food supply as the South American winter approaches. Information on **Berenson** is available on the Web: <http://www.tiac.net/users/salem/lori_berenson/>.

Mark Naugle is an associate product manager for **Activase** at **Genentech**, Inc.

Tim Dawson-Townsend recently completed a master's in engineering management and systems at the University of Dayton. Tim is a captain in the U.S. Air Force and was recently selected to participate in the Air Force's engineer and scientist exchange program. After language training, Tim will report in August to **Braunschweig**, Germany, where he will work with Germany's federal aerospace research agency, the **DLR**, for two years on in-flight simulator aircraft research. His wife, **Kathy**, and their puppy, **Linda**, will join Tim in Germany.

Jennifer Jackson and **Chonda Foster**, '92, are at **Indiana University** in the first year of the MBA program. Jennifer remarks, "It's fun, but **Bloomington**, Inc., is no hopping metropolis." . . . **Kyle Heironimus** has worked for **Digital Monitoring Products**, a design and manufacturing company of corporate and home security systems for two and a half years. He currently supervises a staff of three in DMP's engineering and design department in **Springfield, Mo.** Kyle and his wife, **Beth**, married in December 1991 and expect their first child in July.

Margarita (Rodriguez-Piza) Baverstock was married to her husband, **Paul**, in April 1994. They met while both were consultants at the **Mitchell Madison Group**. **Margarita** is now working on an MBA at **Yale**. . . . **Juan Latasa** worked for two years after graduation for two software firms and then attended business school (**IESE**, in Spain). He has since worked for two years to establish a consulting practice in Europe for **AT&T**, which Juan finds "exciting."

Please send your news to: **Andrew Strehle**, secretary, 59 Commonwealth Ave., Apt. 4R, Boston, MA 02116; tel: (617) 450-0637; e-mail: <astrehle@brfg.com>

92

5th Reunion

I can't do the whole story justice in these Class Notes but I wanted to note that **Lori**

Berenson, a former MIT student, was arrested on November 30, 1995, in Peru and given a

life sentence. (See *TR*, May/June 1996, p. MIT 38.) She has not been given a fair trial and it is not clear what led up to her unwarranted arrest. Her parents and many other supporters are currently trying to do whatever they can to help **Lori's** situation. If anyone would like the information I have, you can e-mail, call, or write me and I will forward it to you directly. Or e-mail her parents, **Rhoda** and **Mark Berenson**: <marbb@cunyvrm.cuny.edu>. Though **Lori** was not in our class—I feel that this is important information and that as a human being, an American, and an MIT peer—**Lori's** case information should be available in the event that we may be of some assistance.

Kathryn Fricks now works for **Hughes Space and Communications** in **El Segundo, Calif.** She says that **Hughes** is hiring a lot of people from MIT, and she is enjoying Southern California. . . . **Saul Nuccitelli** writes, "I spent two months in Europe with **Diane Hodges**, '95. We were walking down a street in Prague and ran into **Joanna Stone** and **Jenn Singer**. In September, **Diane** and I moved down to **Austin, Tex.** I am currently working with **Espey, Huston, and Associates**, an engineering and environmental consulting firm." . . . A quite belated congratulations to **Irene Chow Maar** who was married last July to **Carey Maar**. **Irene** is a brake design engineer at **Ford** in **Detroit** and **Carey** is a computer analyst. **Irene** has also been quite helpful to me in relating e-mail addresses to me of other class members while I attempt to get a class list together to keep you all informed on the Net. In this vein—while I would like to help connect everyone more—I am concerned that a few of you out there do not want their e-mail addresses floating around without permission. I will try my best to keep such address information confidential—but you can help me by writing and letting me know how you feel on the matter.

Sande Chen recently attended the 38th Annual Grammy Awards in LA as a nominee! Wow! She was nominated as a music video director in the category of Best Music Video, Long Form. She has a Web page under construction at: <<http://www-scf.usc.edu/~slchen/>>. . . . **Rajesh Raghavan**, a diligent notes contributor, writes that he went to law school at **Vanderbilt Uni-**



The wedding of Irene Chow, '92 and Carey Maar, (l to r: Adelina Yen '91; Dawn Watkins Chow, '92; the groom and bride; John Watkins Chow, '92; and Terence Chow, '94. Standing: Seth Cohen, '92; Enrique Herrera, '91; Mohsin Ansari, '92; Mike Gull, '92; Henry Chung, '93; Albert Cheng, '92; Cecelia Park, '92; Leslie Hao, '91; Darby Clayson, '91; and Ellen Shen, '91. Not pictured: Jeff Schwartz, '92.

versity until May '94; worked with MIL 3, Inc., in Washington, D.C., and Boston; and started graduate work at the University of Michigan in September '95. He's also hoping to hear from Vijay Vaitheeswaran, '90 . . . Recently I heard from our class prez Aileen Lee who is at Harvard Business School with other classmates. Aileen was living in China last year and, although it was great, she is excited to be back in the states. She and Joanna Stone, Roopa Mehendale, Barb Sigmund, Mike Gull, Seth Cohen, Albert Cheng, myself, and a few others have started communicating about reunion stuff. Yes, believe it or not, here it comes—next summer—our five-year reunion! I expect to see everyone there. Lots more mail to come next month especially from Charlie Choi and the '92 Sigma Chi pledge brothers, so stay tuned. Keep it up gang! I'll be away in Russia and Finland for the summer, until July 28. Then, if you want to reach me in August please send news for this column to: Leslie Barnett, secretary, 2644 Vrain St., Denver, CO 80212; tel: (303) 433-4476; e-mail: <labarnet@ouray.cu denver.edu>.

93

Boston is finally starting to thaw after a long hard winter. I am getting ready to go on spring break, if only I can survive my next set of exams! Then I'll be off to Columbus, Ohio, for the wedding of Shiang Yeh, '92, and Mike Duffy, '92.

Patty Prince has been accepted to Yale Medical School. Her husband, Chris Prince, '92, was accepted to Sloan School of Business. At the moment Chris is planning to defer his MBA for a year, while Patty gets started on her medical degree. . . . Celia Dieterich and her husband, Matt

Dieterich, '91, will be returning to Boston this fall. Celia will be in the Leaders in Manufacturing Program at Sloan and Matt will be working on a master's at MIT. . . . Horace Kelly is working on his PhD in biomedical engineering at the Thayer School of Dartmouth. In June, Horace will be married to Dreama Sloan (Wellesley '95).

Christopher Cotton has been working the past year on Cyberdog at Apple (which has just been released to the Internet community). Besides world travel, his latest project is legalizing ferrets in California. . . . Ari Mozes is engaged and getting married to Kristine O'Malley (whose brother is Tim O'Malley, '92). They will be married in California. . . . Christine Goddard is engaged to Simon Delagrave, PhD '95.

Derek Atkins moved back to Boston from California. He was working for Sun Microsystems on network security products out in Menlo Park, Calif., and now is doing the exact same thing out of the Chelmsford, Mass., site. Most

of Derek's time is spent writing PGP3, the new and improved security tool that "I suspect will take over the industry when it is released."

Gargi Sircar is currently working for Citibank. She has been sent to Singapore for work. . . . Jonathan Li is about to finish the first year of the master's program in human factors engineering at Tufts University. . . . Hooman Davoudiasl has been doing research at Caltech for the past few months.

Joshua Levinson completed the SM program in chemical engineering practice at MIT in 1994. Now he is in his second year of a PhD in chemical engineering at Stanford University. . . . Andy Howe is still figure skating, skiing, snowboarding, and making furniture. He has also embarked upon a new career making prosthetic wooden legs. While Andy doubts he'll have much audience for custom legs made of expensive wood, they "look fabulous . . . while helping someone else limp with style." . . . Carrie Allen is finishing up a degree at Oxford and has accepted a job at General Electric Aircraft Engines in Cincinnati. She's looking forward to not being a student and getting a real paycheck. At the end of April, Carrie will be seeing Julia Stowell who's at Ullinois/Urbana-Champaign. She is also going to Stacey Reeves' wedding in Portland at the beginning of July. As for Carrie, "Hopefully my fiancée and I will have decided on a wedding date by then."

On a recent trip to Atlanta, Larry Olivier saw Alou Macalou, '92, who is working on a PhD in aero/astro, specifically control theory. Larry has also been to Phoenix, where he saw Kathy Nelson, who is working for Motorola in their semiconductor products sector.—Mari Madsen, secretary, 85 Alberta Rd., Brookline, MA 02167; e-mail: <mmadsen@opal.tufts.edu>

94

Please send news for this column to: Jeff Van Dyke, secretary, 6000 Shepherd Mountain Cove #1401, Austin, TX 78730; e-mail: <jvandyke@trilogy.com>

95

Please send news for this column to: Ranjini Srikantiah, secretary, 21 Beacon St., Apt. 2T, Boston, MA 02108; e-mail: <srikantiah@idx.com>



A gathering of '93 MIT alumnae in New York City (l to r): Carmen Perex de la Cruz, Jane Bae, Julie Chang, Eleanore Kim, Julie Lew, Quyen Chu, Aoy Tomita, a friend, and Vinuta Mohan.

CourseNews

CIVIL AND ENVIRONMENTAL ENGINEERING

Raymond Johnson, SE '63, SM '63 (XI), of Rockville, Md., writes: "I currently serve as president of Key Technology, Inc., which has made over 700,000 radon measurements since 1986, and as president of CSI-Radiation Safety Training, which has a contract with the National Institutes of Health. My other professional affiliations include treasurer of the Health Physics Society and president of the American Association of Radon Scientists and Technologists." . . . Leonard B. Richardson, SM '88, writes: "I am now working as a biomedical engineer at Integ, Inc., in Minnesota. We are developing a painless and bloodless blood-sugar monitor for diabetics." . . . Stanley M. White, SM '76, CE '76, writes: "Ocean & Coastal Consultants of Trumbull, Conn., is growing! We are the construction managers for the New York City Department of Sanitation and the Marine Borer Protection Project. We prepared the dredging protocol for the Boston Harbor Navigation Improvement Project." . . . David Damm-Luhr, PhD '79, writes: "I am the head of U.S. Department of Transportation/Volpe Center's change management division, providing consulting services to government agencies in strategic planning, organizational assessment and design, and technology planning and implementation." . . . Upon retiring in July 1995, Leon R.L. Wang, ScD '65, became a professor emeritus at Old Dominion University. He has since joined Infra-Tech, Inc., as executive VP, and formed Wang and Associates, a consulting/service firm located in Norfolk, Va." . . . Daniel Lieberman, SM '82, writes: "My company, Hologramas de Mexico, has been growing quite dramatically in the past few years, and now sells 80 percent of its products outside Mexico. We expect to set up a manufacturing facility in the United States this year." . . . Lieutenant Commander Dan Berenato, SM '88, is a civil engineer at the U.S. Naval Air Station Oceana, in Virginia Beach, Va. . . . Tom Maddock, SM '51, the president and CEO of Boyle Engineering Corp. for more than 20 years, was made an honorary member of the American Society

of Civil Engineers for having attained "acknowledged eminence in engineering." His leadership is largely responsible for Boyle's growth from 4 offices in California to 20 offices nationwide. He has consulted on civil, sanitary, and water resources engineering projects, with combined construction costs totaling more than \$1 billion worldwide. Maddock holds a BS in civil engineering from Virginia Polytechnic Institute and an MBA from Stanford University's Graduate School of Business. . . . Navy Commander John M. Kucinski, SM '85, recently retired from the U.S. Navy after 20 years of service. Kucinski concluded his naval career with a highly successful tour as commanding officer of Amphibious Construction Squadron Two based in Norfolk, Va. Kucinski reported to the squadron after serving as the resident officer in charge of construction in Naples, Italy. During his career, Kucinski has served in many challenging positions. The Franklin, Wisc., native received his commission from the U.S. Naval Academy in 1975 and reported to the frigate USS *Donald B. Beary* for his first tour of duty. He also served aboard the aircraft carrier USS *Forrestal*; at the Navy Public Works Center, San Diego; and at the Naval Facilities Engineering command in Washington, D.C. Kucinski's decorations include the meritorious service medal, two Navy commendation medals, the Navy Achievement Medal, and numerous campaign and unit commendations. Kucinski, his wife, and three children, Christopher, Ryan, and Maria, will now reside in the Boston area.

Jacob A. Samuelson, SM '40, of Seattle died on October 23, 1995, after a long illness. He graduated from the University of Washington with a BS in civil engineering. During World War II, he worked at Todd Pacific Shipyards. He was associated with General Construction Co. for 22 years.

MECHANICAL ENGINEERING

Dwight E. Beach, Jr., SM '65, reports: "I am the president of Houston Engineers, Inc., a world leader in drilling jars and accelerators,

which has financially supported the MIT Enterprise Forum of Texas for 10 years. We now have our products in Vietnam to assist in developing their oil industry. Twenty-five years ago, I was a U.S. Army officer there. How ironic!" . . . Nathan J. Delson, PhD '94, sends word: "I teach design courses as a faculty member at Yale University's Department of Mechanical Engineering. Check out our Web site at <<http://www.yale.edu/me489/>>." . . . Wen Shyong Chiu, ME '69, ScD '71, reports: "I am the national intelligence officer for global and multilateral issues with the Defense Intelligence Agency."

Richard H. Johnson, SM '80, writes: "As business director of Rockwell's automotive electronics division, I am working on vehicular applications of GPS satellites. One is a turn-by-turn navigation system available in the Oldsmobile Guidestar. The other is a mobile emergency response system."

Blake David Mills, SM '35, of Seattle died on December 29, 1995. He served in the Naval Reserve from 1941 to 1946, when he retired as a captain. He then taught in the mechanical engineering department at the University of Washington from 1946 to 1977, retiring as a professor emeritus. . . . The Association of Alumni and Alumnae was notified that Matthew Charles Ek, SM '48, of Chico, Calif., died on September 30, 1995, and Wilbur Manly Skidmore, SM '36, of Nokomis, Fla., died on August 23, 1995. No further information was provided.

MATERIALS SCIENCE AND ENGINEERING

The Minerals, Metals & Materials Society (TMS) selected Bruce W. Wessels, PhD '73, professor of materials science and engineering at Northwestern University, as its 1996 president. At Northwestern, Wessels also holds a joint appointment in electrical engineering and computer science and serves as the coordinator of the electronics materials program. He joined the faculty in 1977 as an assistant professor and was promoted to professor in 1983. Prior to his positions at Northwestern, he worked at the General Electric Research and

DEGREE CODES

AE	Aeronautical Engineer
BE	Building Engineer
CE	Civil Engineer
CHE	Chemical Engineer
CSE	Computer Science Engineer
DPH	Doctor of Public Health
EAA	Aeronautical & Astronautical Engineer
EE	Electrical Engineer
EGD	Doctor of Engineering

ENE	Environmental Engineer
MAA	Master in Architecture Advanced Studies
MAE	Materials Engineer
MAR	Master in Architecture
MCP	Master in City Planning
ME	Mechanical Engineer
MET	Meteorologist
MIE	Mineral Engineer
MME	Marine Mechanical Engineer
MNG	Master in Engineering

MPH	Master in Public Health
MTE	Metallurgical Engineer
NA	Naval Architect
NE	Naval Engineer
NUE	Nuclear Engineer
OCE	Ocean Engineer
PhD	Doctor in Philosophy
ScD	Doctor of Science
SE	Sanitary Engineer
SM	Master of Science



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Bruce Wessels

Electronic Materials, published by TMS and the Institute of Electrical and Electronics Engineers. He holds five patents.

Congratulations to **Robert S. Feigelson**, SM '61, a professor at Stanford University, who writes: "I received the triennial Laudise Prize from the International Organization for Crystal Growth in 1995 in the Hague, the Netherlands, for outstanding contributions in experimental research." . . . **Ronald E. Allred**, ScD '83, reports: "I am developing new recycling technologies for plastics, composites, and electronics." . . . **Tracy B. Braun**, ScD '74, writes: "I have accepted a two-year position at RTZ Technical Services Ltd., in Bristol, U.K., as a senior metallurgical consultant. I have held a number of technical and operating positions at Kennecott during the past 22 years. Most recently, I was a process manager at Kennecott's canyon mining company in Salt Lake City, Utah." . . . **Frank E. Woolley**, ScD '66, writes: "I am developing new melting processes for specialty glasses at Corning, Inc." . . . **Varadachari Sadagopan**, SM '60, MTE '61, ScD '65, writes: "After 26 years with IBM's research division, I started my own company, Network Multimedia Services. Projects include multimedia programs, online services, and distance learning. In my last position at IBM as university relations executive, I searched for ways to strengthen the ties between IBM and MIT. The discipline of materials science and engineering was clearly an area of considerable interest to IBM. I am delighted to read about the excellent news on the MIT Department of Materials Science and Engineering's top placement among the MSE departments of the nation."

IV ARCHITECTURE

Kurt Eichenberger, MAR '82, writes: "My wife, Donna Anderson, and I have purchased an old industrial building in downtown Raleigh, N.C. The building was originally a blacksmith and machine shop, built in 1925. We are renovating the structure with our first step involving the removal of the trees growing through the roof. We plan to move my architecture office there, and will lease space to local artists and designers." . . . **Robert H. Dietz**, MAR '44, writes: "We moved to Gold Canyon, Ariz., last August. It's a great place: sunshine, golf, good neighbors, etc." . . . **Walter Rask**, MAR '85, is manager of architecture and planning at the Centre City Development Corp., a subsidiary of the San Diego Redevelopment Agency. . . . Congratulations to **Daniel Ng**, MAR '86, who reports: "I received a JD

Development Center. He earned a BS in metallurgy and materials science from the University of Pennsylvania. Wessels has published more than 140 technical articles and has edited four books. He currently serves as guest editor for *Annual Reviews in Materials Science* and has served on the editorial board of the *Journal of Electronic Materials*, published by TMS and the Institute of Electrical and Electronics Engineers. He holds five patents.

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Irving Hand, MCP '47, writes: "I am professor emeritus of state and regional planning at Penn State and principal emeritus at Delta Development Group. I also wrote a chapter on

planning practice in Pennsylvania for *International Handbook on Planning Practice* published by the International Society of City and Regional Planners." . . . From Cambridge, Mass., **Craig A. Whitaker**, MAR '83, writes: "After graduation, **Hauke Reisen**, MAR '83, and I started a firm specializing in wood-frame residential work. Then, after a long hiatus from architecture, I co-founded a firm specializing in owner representation on construction projects. In 1995, I took the architectural/licensing exam and expanded my firm's services to include architecture. My firm, **Craig Whitaker Architects**, recently renovated an old Victorian house in Belmont. In my spare time, I'm working on my firm's home page and on an old Victorian home I purchased. Friends or colleagues can reach me at <<http://www.channel1.com/users/cwhita>>; they can send me e-mail from there. Cheers!"



Angela Watson

The Boston-based international architectural firm, **HDS + G, Inc.**, has named **Angela E. Watson**, '91, MAR '93, an associate. Watson, a resident of Brookline, grew up and studied architecture in Germany before coming to the United States. As a senior designer at **HDS + G**, Watson is working on several office and residential developments in Berlin. She is also the firm's specialist in computer-aided design and 3-D computer modeling.

Vernon F. Shogren, MAR '52, died on December 6, 1995, at the age of 71. He was born and raised in Carlton, Minn. Shogren received a BA from the University of Minnesota in 1950, a certificate from the Technische

THOMAS P. MELOY, '51, PhD '61 (III), (left) *Benedum Professor and director of the Particle Analysis Center at West Virginia University, was named a "Distinguished West Virginian" by Governor Gaston Caperton earlier this year. The award is the highest honor bestowed by the governor on a citizen of the state. Caperton acknowledged Meloy's "many seminal contributions to science and engineering, attested to by more than 500 publications as well as the numerous awards*



he has received during his long, innovative, and brilliant research and teaching career." Earlier this year, the American Institute of Mining, Metallurgical, and Petroleum Engineers honored Meloy with the "Mineral Industry Education Award." The citation reads: "To a gifted, inspiring educator for his exceptional ability to educate through his outstanding research; brilliant lectures; illuminating, defining papers; and innovative, imaginative courses. A Renaissance Educator."

Hogeschole (the Netherlands), and a Fulbright Scholarship in 1952-53. He taught at the School of Design at North Carolina State University from 1953 to 1955 and from 1961 to 1992, when he retired. He was named to the university's academy of outstanding teachers in 1964-65 and 1969-70, and received a distinguished alumni professorship in 1972-75. He was known as a challenging teacher who focused on conceptual issues. In a survey conducted by the *North Carolina Architect* in 1977, Shogren was mentioned most often by School of Design graduates as having profoundly influenced them. Shogren's practice experience included a number of years with the firm Eero Saarinen & Associates. He was an architectural designer on such projects as the London and Oslo embassies and University of Chicago Law School. Upon his retirement, Shogren established an endowment fund that is intended to encourage free thinking coupled with objective reasoning in explorations of architecture and environmental design.

V CHEMISTRY

From Bethlehem, Pa., Donald Smyth, PhD '54, reports: "Along with three co-authors from Sandia National Labs, I was awarded the 1995 Edward C. Henry Award from the electronics division of the American Ceramic Society for the best paper on electronic ceramics to appear in the society's journal during the previous three years. I also won this award in 1987 for the best paper during the previous 10 years." . . . Thomas J. Porro, SM '58, from Westport, Conn., writes: "I spent 33 exciting years with the Perkin-Elmer Corp., an analytical instruments firm, in various marketing capacities (application chemist, product specialist in spectroscopy, and product manager). I retired in 1991 to a life of consulting, playing tennis, woodworking, and general handyman. I am currently a member of the Chemical Instrumentation Museum Group of the Chemical Heritage Foundation in Philadelphia." . . . Philip E. Rakita, PhD '70, reports: "I recently returned to Paris after a two-year assignment in Japan to join Elf Atochem Agri, S.A., as a business manager. I am responsible for products that control plant diseases in vineyards." . . . Keith Pope, PhD '87, writes: "I am continuing to work at IBM Research in Yorktown Heights, N.Y." . . . Forrest W. Getzen, PhD '56, retired at the end of 1994 as a professor in the chemistry department at North Carolina State University after 34 years of service. . . . R.P. English, PhD '70, is VP for operations at Alcatel Comptech, a San Jose, Calif., manufacturer of thin-film vacuum processing equipment for the thin-film head, micromachining, and microconnector market. . . . Jotham W. Coe, PhD '88, writes: "I am a senior research investigator in the neurosciences department at Pfizer, Inc., in Groton, Conn. I married Linda S. Jaynes in June 1995." . . . From Westlake Village, Calif., John T. Viola, PhD '67, reports: "I continue to work at the Rockwell Science Center on infrared detectors and sensors. This area continues to have strong support for funding and is starting to receive attention for commercial applications such as astronomy and earth observation. Other than work, a major joy of my life has been the

When Handed Less Wood, Goldstein Made A Showcase Library

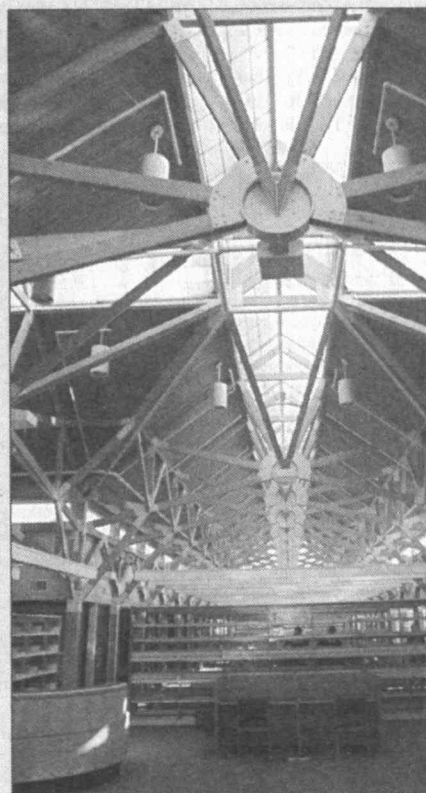
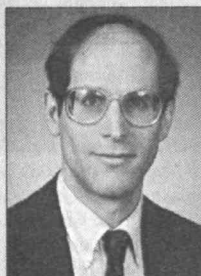
When skyrocketing lumber prices threatened to destroy plans for the Montville (N.J.) Township Library that Eliot Goldstein, '77, MAR '80, was working on in 1992, he had to act quickly. "Neither the library board nor I wanted to sacrifice the wood or the design," he recalled.

"So I came up with a scheme that would preserve the basic concept but make it more efficient." To support the structure, Goldstein designed steel braces to simultaneously connect up to 10 pieces of wood in a three-dimensional manner. By sidestepping the conventional need for large wooden columns and bearing walls, he gave the \$4 million library an open, barn-like quality. As compared to his original plans, Goldstein's new scheme eliminated 35 tons of lumber and cut timber costs by nearly 20 percent.

Goldstein acknowledges MIT's influence on his career: "While an undergraduate, I took several courses on building structures taught by Professor Leon Groisser, '48, ScD '70, and an architecture design studio taught by Professor Edward Allen. Before the start of graduate school, I was part of the crew working on the construction of Allen's wood-framed house, which was un-

usual due to its steeply sloped roof and solar heating provisions. As a graduate student, I took his course on the design and engineering of wood structures and was a teaching assistant for the course on basic building construction. Out of this intensive exposure to the design and engineering of wood structures, I developed a keen interest in the field."

ENR (formerly *Engineering News Record*), a design and construction magazine, named Goldstein one of the top 25 newsmakers for 1995. ENR recognized Goldstein's design for the Montville Township Library for creating "an instant landmark." The library



The sequential scissor-like trusses Eliot Goldstein designed for the Montville Library formed a peaked roof that provides a continuous skylight.

has appeared in *Building Design & Construction*; the Canadian Wood Council's journal, *Wood/Le Bois*, and its *Wood Reference Handbook*; and a Japanese book on innovative uses of American wood products. □

—STEPHANIE V. GREPO

delight of my two granddaughters, who reside in nearby Pasadena. My wife and I find every opportunity to visit them." . . . **Howard S. Corey**, PhD '55, reports: "I have relocated from Rockland County, N.Y., to Brick, N.J., where I hope to expand my business as a certified financial planner." . . . The Bank of Boston Corp. appointed **Paul Hogan**, SM '68, executive VP for corporate relationship banking. Hogan, who has been with the Bank of Boston since 1974, has broad experience in commercial lending, in asset-based financing, specialized industries, and project finance, as well as problem loan workouts. Hogan received a BS in chemistry from Boston College and an MBA from the Amos Tuck School at Dartmouth College. Hogan served as a first lieutenant in the U.S. Army, and prior to attending business school, worked for McCord Corp. of Detroit as a chemist supporting manufacturing businesses in Argentina and Brazil, as well as the United States.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

John Mitchell, SM '82, PhD '84, writes: "I studied the mathematical semantics of programming languages from July to December 1995 at the Isaac Newton Institute for Mathematical Science in Cambridge, U.K. I'm happy to be back now in sunny California rubbing shoulders with the computer industry again." . . . **Arthur D. Hughes**, SM '54, from Gladwyne, Pa., reports: "After 14 years of development engineering at Technitrol,

Inc., a manufacturer of currency handling equipment, I retired at the end of 1995. But I am continuing part-time this year. I was a co-author of a patent, 'Document Counting and Batching Apparatus with Counterfeit Detection,' issued on July 4, 1995." . . . **John L. McKelvie**, SM '49, of Dresher, Pa., writes: "I have retired from Digital Equipment Corp. I miss the challenge of devising and presenting computer-based systems to customer problems, but appreciate the new freedom, for example, to visit my children and grandchildren in Michigan." . . . From San Francisco, **Abhay Parekh**, SM '86 (XV), PhD '92, reports: "I'm currently principal architect for network services at Sun Microsystems. We are working toward building the badly needed infrastructure that will make the Internet 'business friendly.'" . . . **W. Guy Redmond**, SM '51, is an aerospace engineer at Loral Vought Systems in Dallas, Tex. . . . **Peter G. Jessel**, PhD '72, writes: "I have left EMI Music to become CIO of Towers Perrin in charge of technology worldwide." . . . **Socrates Litsios**, SM '59, ScD '63, explores the history of malaria from an environmental, epidemiological, and socio-economic viewpoint in *The Tomorrow of Malaria*. The book is published by Pacific Press and distributed by Natural History Book Service in the United Kingdom.

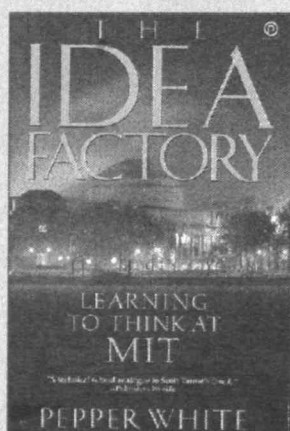
Cognex Corp., which was founded in 1991 by **Robert Shillman**, SM '72, PhD '74; **William Silver**, '75, SM '80; and **Marilyn Matz**, SM '80, was honored last year by Tokyo Seimitsu Co., Ltd., (TSK) with a supplier appreciation award. It was the first time in TSK's 50-year history that the company presented this award to a U.S. supplier. Cognex Corp. designs, develops, manufac-

tures, and markets machine vision systems. One of the largest applications for these systems is guiding the placement of surface mount devices onto printed circuit boards. A robotic "gripper" picks up each device and holds it over an upward-viewing camera. The vision system captures an image and inspects the device to check that it is correctly formed. As the gripper moves over the printed circuit board, a downward-viewing camera captures an image of the board. The vision system locates the placement site on the board and determines the exact movement required for the part to be positioned correctly.

Steven V. Sperry, SM '78, of Palos Verdes, Calif., writes: "I am happy to report that things are picking up in Southern California. My division at TRW, the space and electronics group, hired 500 people last year and we hope to hire another 500 this year. I was fortunate enough to be asked to recruit at MIT this past fall. I was extremely impressed with the students I interviewed. Considering their coursework, work experience, and research projects, they all appeared to be well-prepared to enter the work force. When I'm not working and recruiting, I spend my time volunteering at my son Andrew's Boy Scout troop or watching my daughter, Kaoru, play soccer."

The Association of Alumni and Alumnae was notified that **Dale Pollack**, ScD '40, of Clearwater, Fla., died on January 25, 1994. He was a professor at Tuskegee Institute until his retirement in May 1993, but was about to start teaching again at Luke Air Force Base in Arizona at the time of his death. In 1975, he taught at the University of Negev in Israel. In

LEARNING TO THINK AT MIT



The Idea Factory by Pepper White

When Pepper White enters MIT, one of his professors tells him that it does not much matter what he studies there. What MIT will do is teach him how to think. The Idea Factory is his revealing insider's account of being a graduate student at America's most prestigious and demanding technological university; even more, it is the story of Pepper White's coming-of-age in a relentless academic pressure-cooker. *Paperback, 313 pages, \$11.95*

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In February, Jay W. Forrester, SM '45, (right) was named a Fellow of the Computer Museum in Boston. Forrester, Germeshausen Professor of Management emeritus at MIT, was honored for his many contributions to computing, including Whirlwind, the first computer based on core memory. Under Forrester's direction, the \$4.5 million computer became the prototype for SAGE, the U.S. air defense system to track and intercept aircraft. Forrester is pictured with Gwen Bell, founder and president of the Computer Museum, where part of Whirlwind is on display, and Robert R. Everett, SM '43, retired president of the MITRE Corp., who was associate director of the Digital Computer Laboratory, which built Whirlwind in the 1940s.



1961, he was the president of New London Instrument Co. He was a fellow of IEEE and listed in the 1994 *Who's Who In America*.

VI-A INTERNSHIP PROGRAM

VI-A managed to get our company representatives in and out for the annual business meeting, the company open house, and two days of interviews. Director Markus Zahn, '67, SM '68, EE '69, ScD '70, is pleased to report a "very successful VI-A application process during the first week of March. Received were 161 applications for approximately 90 new VI-A positions in about 30 company locations; final matching of students and companies was completed by early April. We have two new VI-A companies: American International Group of New York City, an insurance and financial services company, and SQA, Inc., of Burlington, Mass., which develops Windows-based client/server applications."

It is always a pleasure to welcome back alumni as company representatives for the VI-A interviews. As best we can recollect from our records, they were the following: Neil M. Haller, '58, SM '59, EE '61, of Bellcore; Nancy S. Stevens, '81, SM '82, of Bell Labs; William G. Zeng, '95, SM '95, of Comsat; Susan E. Margulies, '92, SM '93, of Hewlett-Packard in Andover; Ganesh N. Ramaswamy, '92, SM '92, EE '93, PhD '95 of IBM; Gary J. Tarnowski, '93, SM '94, of Loral; Stephen P. Emeott, '89, SM '90, of Motorola/Schaumburg; Jenny M. Ford, '81, SM '82, of Motorola in Mesa, Ariz.; Robert P. Gilmore, '76, SM '77, and Frank J. Gutterman, '91, SM '92, of Qualcomm; Charles B. Dietrich, '56, SM '58, of Sarnoff; Jeffrey D. Beck, '71, SM '72, of Texas Instruments in Dallas; and Luis H. Rodriguez, '90, SM '93, of Xerox/PARC.

A project of mine, establishing in the Jackson Room a memorial library of books written by department faculty, is growing successfully. Donated books, which often have the author's signature, have been coming from libraries of deceased faculty as well as from retirees and current faculty. Perhaps you have texts you'd like to donate, such as a first edition of *Principles of Radar*. I've established a card file and

can tell you what we already have; contact me if interested.

Department faculty and VI-A students continue to receive honors. Three of IEEE's 1996 Fellows are MIT-related. Two are faculty: James G. Fujimoto, '79, SM '81, EE '81, PhD '84, and Hae-Seung Lee; the third, a former faculty member, is now a staff member at Lincoln Laboratory, James N. Walpole, SM '62, PhD '66. Elected to the National Academy of Engineering is senior research scientist David D. Clark, SM '68, EE '68, PhD '73, of our Laboratory for Computer Science.

Edward J. McCluskey, '52, SM '53, ScD '56, now a professor at Stanford University and director of the Center for Reliable Computing, recently received the IEEE's prestigious Emanuel R. Piore Award for "pioneering and fundamental contributions to design automation and fault-tolerant computing."

MIT's School of Humanities, Arts, & Social Sciences has selected 31 students to be this year's Burchard Scholars. Two are VI-A juniors: Lawrence K. Chang and Grant Y. Smith.

Signing our VI-A Guest Book, since last writing, have been: Richard Chin, '80, SM '81, of Los Altos, Calif., on campus recruiting for Hewlett-Packard; Jonathan L. Sherred, '88, SM '88, recruiting for HAL Computer Systems of San Jose, Calif., who also mentioned his brother Mark A. Sherred, '82; Stephen M. Slivan, '84, SM '86, '89 (XII), SM '89, PhD '95 (XII), who is a post-doc teaching astronomy at MIT; and Neil H. Tender, '93, SM '94 of Potomac, Md., who's with Hughes Network Systems.

Others about whom we've heard include: Alan R. Hirsch, '66, SM '67, who is the Tau Beta Pi district director for District 8 (oversees 16 chapters) and is national director of rituals; Kay L. Hsu, '90, SM '91, working for H-P in San Diego; Harry F. Raab, Jr., '50, SM '51, retired in 1995 after 43 years with the Naval Nuclear Propulsion Program, the last 23 as chief physicist of the Nuclear Propulsion Directorate, and now the stewardship chairman for the Episcopal Diocese of Virginia; and Raymond S. Stata, '57, SM '58, who is stepping down, after 31 years, as the chief executive of Analog Devices, but will remain as chairman of the board. Analog Devices has

leased a building that MIT purchased from Polaroid to set up a manufacturing plant to produce tiny accelerometers. The plant is expected to provide some 100 new jobs and will bring Analog's presence back to Cambridge where it began some 30 years ago.—John A. Tucker, director (emeritus) and lecturer, VI-A Program, MIT, 77 Mass. Ave., Rm 38-473, Cambridge, MA 02139-4307; e-mail: <jat@fenchurch.mit.edu>.

VII BIOLOGY

Marita D. Stratton, MPH '41, writes: "Greetings to all who knew me at MIT! My husband, Charles, and I celebrated our 50th wedding anniversary in 1994 in Woodstock, Vt., with our five sons (two physicians, an architect, a research chemist, and a lawyer), their spouses, and 13 grandchildren. We are proud of our family. I serve on the boards of the Lee Visiting Nurse Association, the Lee School Building Commission, and the local American Cancer Society. Charles is retired, but still active with several medical groups."

Clemens E. Prokesh, SM '45, writes: "I continue to practice internal medicine. I am also VP of the German Club of Eastern Connecticut. I have also often wondered how my faculty advisor, Irwin Sizer, is."

Menicon Co., Ltd., the leading manufacturer of contact lenses in Japan, has endowed the Menicon Professorship in Neuroscience at MIT. The \$2.5 million philanthropic gift will be used to recruit a professor to the MIT Center for Learning and Memory, a laboratory headed by the Nobel Laureate Professor Susumu Tonegawa. Tonegawa, who holds the Amgen Professorship of Biology and Neuroscience and a joint appointment in the Departments of Biology and Brain & Cognitive Sciences, said, "I am delighted to receive this gift from Menicon, a public-spirited company that recognizes that the MIT Center for Learning and Memory is addressing one of the greatest and most exciting challenges in the biological sciences today—the understanding of the human brain."

VIII

PHYSICS

The Institute of Physics (London) awarded the 1995 Kenneth J. Button Medal and Prize in Far Infrared Physics, which is given annually in recognition of outstanding contributions in the field of infrared and millimeter waves, to **Richard J. Temkin**, PhD '71, a senior research scientist in the MIT Department of Physics and head of the waves and beams division of the MIT Plasma Fusion Center. His citation reads: "For leadership in the research, development, and application of high-power coherent sources at infrared and millimeter wavelengths, especially the high-frequency gyrotron." The gyrotron is a microwave generator that operates at cyclotron resonance in a high-magnetic field. The gyrotron is used in plasma heating, radar, electron spin resonance spectroscopy, and other scientific and industrial power applications. Temkin and coworkers were the first to demonstrate a high-power gyrotron at a frequency above 100 GHz in 1982.

Sol Aisenberg, PhD '57, reports: "My company, International Technology Group, has introduced a new service called 'Free Inventions by Request.' One of our latest patents pending is for improved fluorescent lights. Other inventions include a low-cost, simple system to hamper carjacking and car theft. A developing invention involves devices to help the handicapped use computers. Under final construction is neural net software for forecasting." ... **Charles W. Tittle**, PhD '48, writes: "After retiring as professor of physics at Southern Methodist University, I continue to consult in nuclear well-logging development three to four days per week. I began this with my research at MIT in 1947." ... **Francine Wright Bellson**, SM '75, of San Jose, Calif., writes: "Since my marriage to composer/drummer Louie Bellson in September 1992, we have given motivational seminars to diverse audiences nationally as a team known as 'The Physicist & The Percussionist.' Our 1995 presentation to the Northern Illinois University Department of Physics received support from the American Physical Society Committee on Minorities (& Women) in Physics, which listed me on their colloquium speakers roster. Call (818) 983-2600 for more information."

X-A

CHEMICAL ENGINEERING PRACTICE SCHOOL

This column benefits from all the news that accompanied the year-end giving of last December. And you thought that new technology had converted publishing from a craft to an overnight miracle. . . .

Here goes, from the oldest to the youngest. From Key Largo, **David Brown**, SM '40, writes of his pleasure in retirement with winters in Florida and summers in Highland, N.C. . . . **Robert Snedeker**, '50, SM '51, is in print in nearly every issue of the *Review* as secretary of his undergraduate class, but he pulls our leg with a report on 1995 for his X-A classmates: "Another ho-hum year," he says. "I won the Nobel Peace Prize, sold my script to Walt Disney Productions, and won the Boston Marathon." ... **Peter Silveston**, '51, SM '53, continues to commute between his

academic job at the University of Waterloo, Ontario, and his soon-to-be retirement home on Kiawah Island, S.C. He writes that his newest start-up company, Gargoyles and Windcocks, "seems to have survived its critical first year." Another joke? We think not, but Silveston leaves us to guess the nascent company's business. . . . **J. Ray Bowen**, '56, SM '57, is stepping down as dean of engineering at the University of Washington and will return to teaching chemical engineering. . . . **Allan Bergman**, SM '58, is now corporate VP for Latin American operations of National Starch and Chemical Co. from his office in Bridgewater, N.J.

David Nickles, '62, SM '65, started working on the countertop material Corian® with the Du Pont company upon leaving MIT, and he's been at it ever since. He began as process development engineer, holds a patent related to the product, and late last year was honored by the company as one of five "Pioneers of Corian®." . . . From **Steven Wilson**, SM '75, in Westfield, N.J.: "I am a division president of Trans Technology Corp. with responsibility for the Palnut Division that consists of the Palnut Co., Industrial Retaining Ring Co., and Waldes Truarc Co. With three profit centers and \$50 million in sales, I am generally fully occupied!" ... **Steven De Cicco**, SM '77, has a new job: he's commercializing a flameless thermal oxidizer for treating emissions from petroleum, chemical, and pharmaceutical processing as engineering director of Thermatrix, Inc., in Knoxville, Tenn. And **Douglas J. Golding**, '87, SM '88, is a second-year resident in family medicine, and his wife, Kathy, is a first-year resident in the same specialty.

From Carol Phillips at the SCEP office: **Jianfeng Lou**, and his wife, Wei Li, are parents of Michelle Bungqian, born February 3. Lou is now working on a PhD at MIT. . . . **Vivek Mohindra**, SM '90, visiting MIT to recruit for McKinsey & Co., said working in the financial world "is just like Practice School. All the things I learned are coming into use," he told Carol. . . . From Santa Barbara where she's working on a PhD in chemical engineering at UC/Santa Barbara, **Cora Dancy**, '93, SM '93, writes that she's to be married in August to Michael Leibig, a UC/Santa Barbara physics post-doc. She hopes for a PhD in June 1997, and she and Michael are already wondering what's next.

The deaths of five SCEP alumni have been reported: **Anthony R. Savina**, '30, SM '31, last August 29 in Stamford, Conn.; **William B. Littreal**, SM '31, on March 14, 1995, in Roanoke, Va.; **Benjamin F. Schlimme**, SM '35, last October 8 in Tucson; **James G. Baker**, '36, SM '37, on March 3, 1995, in Madisonville, Ky.; and **Paul L. Tillson**, '38, SM '39, on September 23 in Augusta, Ga. Following his tour of the Practice School stations, Savina started at E.L. Patch Pharmaceutical Co. in Stoneham, Mass.; 13 years later he began a 30-year-plus career in the Stamford (Conn.) Research Laboratories of American Cyanamid. He was active in many Stamford community programs and held the Alumni/ae Association's Lobdell Award (1981) for volunteer activities in support of MIT. Littreal retired to Roanoke in the 1960s after a 30-plus-year career in petroleum, first as research chemist for Standard Oil in Whiting, Ind. and after World War II as chemical engineer for the Utah Oil Refinery Co. in Salt Lake City. Schlimme joined Du Pont upon graduating, and when he retired in 1975 before moving to Tucson, he was VP and general manager of

the Du Pont Co.'s international department and had been for eight years a director of the company and of Du Pont of Canada. As head of Du Pont's international department, Schlimme traveled throughout the world to supervise the company's foreign affiliates and 100,000 employees. Following graduation, Baker was on the MIT chemical engineering faculty for one year before joining the Monsanto Co. for work in St. Louis and Norfolk. In 1946, he returned to his native Madisonville, Ky., to manage the family-owned department store, and he became a leader in that community—and in the American Rose Society. A career change marked Tillson's transition to civilian life after World War II. Upon leaving MIT he joined Standard Oil Development Co., Linden, N.J., but by 1948 he was studying patent law in Washington, D.C., and soon thereafter he became a patent attorney for Gulf Oil in Pittsburgh—a job from which he retired to Augusta in 1980.

Send news and views for future columns to any of the following: Carol Phillips, SCEP, MIT Room 66-309, (617) 253-6600, <carolp@mit.edu>; or the undersigned.—John Mattill, *Technology Review*, MIT Room W59-200, Cambridge, MA 02139.

XI

URBAN STUDIES AND PLANNING

Christina Barnes Nova, MCP '72, writes: "After working for CBS News for years, I now teach video production. We moved to Vermont, where my husband, Craig Nova, is working on his ninth novel. **Edward Elliott**, SM '93 (IV, MAS), and I are working with the concept of story-boarding electronically with my students at Landmark College, the only college in the country exclusively for dyslexic and attention-deficit-disorder students." ... **Con Howe**, MCP '75, reports: "I have been director of planning for the City of Los Angeles for almost four years, during which time it has experienced riots, fires, mud slides, and earthquakes. Still, it's a great city with a great future." ... **John D. Amaral**, SM '94, of Attleboro, Mass., sends word: "I am currently teaching and running an environmental consulting business in Massachusetts and Rhode Island." ... **Richard S. Howe**, SM '61, of San Antonio, Tex., reports: "Distance learning is my current focus. I teach both freshmen and graduate students. We anticipate networking with other institutions to import their best and export our best, so learners in South Texas have access to terrific learning opportunities. I'm also working with Roosevelt High School as its teachers and principal undertake its transformation to the Roosevelt School of Technology and Design. I'm a lucky fellow." ... From Lexington, Mass., **Alan Sager**, PhD '79, writes: "I am pursuing health-care coverage for all and making costs fall—teaching that health planning can stop markets from damaging our hospitals to close and ourselves to HMOs." ... **Tomasz Sudra**, PhD '76, writes: "The UNCHS (Habitat) Training and Capacity Building Section [of which he is the chief] has grown and expanded its scope and scale of activities. New manuals and on-the-job handbooks were published for local elected officials as well as a series of training-design manuals in three regional versions: African, Asian, and

European. Central and Eastern Europe became an important area of our capacity building programmes, along with Africa, Asia, and Latin America. A set of handbooks on "Total Quality Maintenance," for operation and maintenance of local services and infrastructure, was published in early 1996." . . . **Tomas N. Rico-Mora**, MCP '84, writes: "Since 1991, I have worked for the International Fund for Agricultural Development (IFAD), a U.N. agency based in Rome, that promotes and finances rural development projects in the less-developed regions of the world. IFAD's projects are aimed at improving the living, income, and productive conditions of the rural poor: smallholders, landless farmers, indigenous groups, and rural women and youth. IFAD is staffed by about 100 professionals specializing in economics, finance, agriculture-related disciplines,

etc. As a project controller at IFAD, I currently oversee the implementation of the fund's project portfolio in the Lusophone- and Spanish-speaking countries of West Africa. The portfolio of these countries comprises artisanal fisheries and agricultural/rural development projects (soil conservation/water management, community-based land management, marketing promotion, etc.). Before joining IFAD, I worked as a consultant to the World Bank (1984-89) and the Food and Agriculture Organization of the United Nations (1989-90), primarily in socio-economic research, agricultural project evaluation/investment analysis, and project design/implementation in a number of countries of Latin America, Asia, and Africa. In my consulting capacity, I worked in the field under various agro-ecological conditions and institutional settings, such as Philippine vil-

CourseNews

lages, Mexican indigenous communities, refugee camps in Mozambique, and the Amazon. I am listed in the 1996-97 edition of *Who's Who in Finance and Industry*."

XII

**EARTH, ATMOSPHERIC
AND PLANETARY SCIENCES**

Judson E. Stailey, SM '78, writes: "I was reassigned to Silver Spring, Md., to serve as the Air Force's representative to the Office of the Fed-

Former DUSP Professor Dies on Mission to Rebuild Bosnia

A former professor in the MIT Department of Urban Studies and Planning (DUSP), **I. Donald Turner**, was among the 34 people killed along with U.S. Commerce Secretary Ron Brown in a plane crash in Croatia in early April.

Turner was one of the twelve executives on the flight who had been asked to help with reconstruction efforts in Bosnia. A leader of low-cost housing initiatives, Turner was the founder and president of the Bridge Housing Corp., a not-for-profit organization that has developed more than 6,000 new homes, mostly for low- and middle-income buyers, in the San Francisco area.

Patrick Cudmore, a classmate of Turner's at the Harvard Graduate School of Design (HGSD), recollected that even as a student, Turner had aspired to construct low-cost housing in developing countries. Cudmore said, "He had a deep concern for the plight of the poor and homeless, and saw provisions of affordable housing as an ideal way to improve their lives."

While at HGSD, Turner became the VP of a local housing firm whose lightweight prefabricated components permitted self-help construction. Cudmore said, "Turner placed great faith in the ability of the poor to build their own homes if given the right resources." Although the business failed when federal grants were delayed, Turner remained undaunted.

While a fellow at the MIT/Harvard

Joint Center for Urban Studies, Turner expressed his long-range hopes in his 1972 PhD thesis, *Industrialized Housing in Developing Countries*. From 1972 to 1976, Turner taught courses at DUSP.



I. Donald Turner

One of Turner's closest MIT associates, Langley C. Keyes, the Ford Professor of City and Regional Planning, said, "Turner was an important part of DUSP during his stint as a professor. He is remembered as a terrific teacher, an inspiring practitioner, and a man of great creativity. As chairman, I welcomed not only his substantive contribution, which was profound, but also his energy, his commitment, and his sense of humor."

In 1973, Turner founded and became executive director of the Urban Home-

stead Assistance Board (UHAB) to promote low-cost housing in New York City. UHAB assisted in the rehabilitation of 1,000 buildings, comprising 25,000 units of tenant-controlled, low-income housing. In recent years, up to 60 percent of the new households have come from homeless shelters.

Turner moved to California in the late 1970s. He taught at the University of California/Berkeley from 1976 to 1981. As the state's director of housing and community development from 1978 to 1982, he oversaw the construction of 5,500 permanently affordable housing units. In 1983, he founded the Bridge Housing Corp.

In recent years, Turner had returned to MIT several times to deliver lectures to graduate students at the Center for Real Estate.

Larry Susskind, a professor of urban and environmental planning in DUSP, said, "Don Turner was one of the most passionate advocates of self-help housing and empowerment of the poor in the United States. From his work in New York City to the affordable housing policies and programs he advocated as secretary of housing and community development in California, to the incredible level of affordable housing production he was able to achieve through Bridge, Inc., he demonstrated a talent and a commitment to taking constructive action that few in the planning field will ever match." □

—STEPHANIE V. GREPO

eral Coordinator for Meteorology and moved to the D.C. area." . . . William R. Tahnk, SM '73, is enrolled in the PhD program in atmospheric science at Oregon State University.

Howard McMurry, ScD '38 died on January 20, 1996. Before coming to MIT, he completed his undergraduate work at Pennsylvania State University and his master's work at Harvard University. He was employed for most of his professional life as senior geophysicist for the New Jersey Zinc Co. in Palmerton, Pa. After his retirement, his community involvement ranged from membership on the board of the regional community college to volunteering at the local food bank. He maintained a beautiful garden on the grounds of his family home up until the summer before his death.

The Association of Alumni and Alumnae was notified that James Edward MacMonegle, Jr., SM '61, of Granby, Mass., a meteorologist with the U.S. Weather Bureau, died on April 22, 1995, and Willem Van Dijk, '58, of Breukelen, the Netherlands, a lecturer at Rijks-Universiteit-Utrecht, died on December 13, 1995. No further information was provided.

XIII OCEAN ENGINEERING

Andrew Summers, SM '73, writes: "I returned a year ago from Bath, England, where I participated in the scientist exchange program and designed future frigates for the United Kingdom. I am presently head of systems engineering for the SC21, the U.S. Navy's next surface

combatant (expected delivery 2010). I live in Annapolis, Md., with my wife. Both our children are now in college." . . . From Orinda, Calif., James E. Kaune, NE '55, writes: "This is my third year operating a start-up company that makes power-producing barges ranging from 200 kw to 300 mw. We have 41 employees." . . . Rich MacDougall, SM '74, of The Woodlands, Tex., writes: "I am director of drilling production for Union Texas Petroleum." . . . Robert B. Hayman, NE '56, writes: "My wife, Marie, and I have been enjoying our Florida retirement since 1993 when I retired from Consolidated Edison of New York. We are busy playing a lot of tennis, some golf, and visiting our 8 children and 16 grandchildren."

XIV ECONOMICS

John Huizinga, PhD '80, professor of business economics and a deputy dean of the faculty at the University of Chicago's Graduate School of Business, has been named the Walter David "Bud" Fackler Professor. Huizinga has concentrated his research on empirical issues in international economics and monetary economics, as well as economic theory. His most recent work in the area of international economics has dealt with predicting long-run movements in exchange rates, the impact of exchange-rate changes on prices in U.S. manufacturing industries, and the effect of exchange-rate volatility on U.S. manufacturers' ability to compete internationally. Huizinga received BA degrees in

economics and mathematics from Pomona College in 1976. A consultant to the International Monetary Fund, Huizinga was co-editor of the *Journal of Business* from 1992 to 1993. . . . Daniel E. O'Neill, PhD '77, was elected a principal of A.T. Kearney, a global management consulting firm. O'Neill joined A.T. Kearney when its acquisition by EDS was finalized in September 1995. O'Neill serves A.T. Kearney clients in the utilities industry from the firm's Atlanta office. His consulting specialties include decision analysis, information systems, and activity-based budgeting. Prior to joining EDS in 1992, O'Neill served as a senior manager of Deloitte & Touche in Atlanta. O'Neill earned a BA in economics from Louisiana State University in New Orleans. He and his wife of 25 years, Nancy, currently reside in Atlanta with their two daughters. . . . Laurence Meyer, PhD '76, is president of Laurence H. Meyer & Associates, a St. Louis economic consulting firm he founded in 1982 with two former students from Washington University in St. Louis. Meyer continues to teach economics to graduate students. Before that, most of his career had been working as a staff economist at the Federal Reserve Bank of New York. In 1981, Meyer had an idea for combining the art of economic forecasting with the number-crunching power of computers and selling the results to banks and institutional investors. By 1983, Meyer's firm had built a huge computer model that generated quarterly economic forecasts and interpretations. A year later, Meyer's firm began analyzing tax reform proposals. His firm has done extensive work for the Reagan, Bush, and Clinton administrations and done numerous presen-

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tations for the Federal Reserve Board. For the second time in three years, he was named forecaster of the year by *Blue Chip Economic Indicators*, a newsletter that publishes the economic predictions of 52 top economists every month. In 1986, *Business Week* magazine named Meyer the top forecaster for the accuracy of his predictions from 1989 through 1992. Meyer is married and has two children.

Captain Arthur A. Cumberledge, SM '41, retired Navy meteorologist whose weather forecasts aided the Allies in World War II, died of complications from heart disease on January 1 at his home in Coronado, Calif. In early 1945, he was dispatched to eastern Siberia to serve as commanding officer of two weather and communications stations. There, in temperatures that often dropped below zero, he provided weather data in eastern Asia to forces planning attacks on Japan. His actions were awarded with a Bronze Star. Early in his Navy career, Cumberledge survived the sinking of the aircraft carrier *Hornet* in a 1942 sea battle. His exceptional swimming skills, developed as a water polo standout at the U.S. Naval Academy, enabled him to swim through oil-thickened waters for hours before being rescued by a U.S. destroyer. Cumberledge lived in Youngstown, Ohio, when he joined the Navy at age 17. After a year of enlisted service, he was accepted at the U.S. Naval Academy in Annapolis, Md. He graduated with honors in 1931 and later studied meteorology at the Naval Academy's post-graduate school. In 1940, Cumberledge served as senior meteorological officer for the atomic bomb test on Bikini atoll in the Marshall Islands. In later years, he was in charge of fleet weather headquarters in San Diego, Pearl Harbor, and Yokosuka, Japan. When he retired from active duty in 1960, he was head of the meteorological department at the Naval Post Graduate School in Monterey. Cumberledge toured Europe in a car with his wife, Mary Louise, after his retirement. For many years, he enjoyed taking long walks in Coronado, where he had lived since 1947.

XV MANAGEMENT

An update from John J. Kinley, SM '50, reads: "I continue in my second year as lieutenant governor of Nova Scotia. As the Queen's representative, I have discontinued my engineering activities. My two sons, who are also professional engineers, operate our family business. My duties, which are very pleasant, included participating last year in a reception for the leaders of the G-7 during their summit in June. It was a very successful and memorable event for this community, the second smallest where the event was ever held." . . . Michael deMarco, SM '68, of Old Greenwich, Conn., is the director of risk management and head of portfolio management for global equity derivatives at GTE-Investment Management Corp. . . . Michael Owen, SM '63, is dean of the College of Business at Montana State University in Bozeman. . . . Karl Miller, SM '63, writes: "Power Jets Unlimited (PJU) has developed Life-Cycle Leasing (LCL) as a method of making available major weapons systems at minimum costs to the U.S. Department of Defense. I am working with two U.S. Air Force generals. We have targeted the C17 and

PATRICIA GARRISON-CORBIN, SM '79, was named Revlon's Businesswoman of the Year. In 1986, she founded P.G. Corbin & Co., which has overseen more than \$52 billion in municipal and state bond sales and ranks third among issuers of taxable and non-taxable debt. She serves as chairman and CEO. The Philadelphia-based P.G. Corbin & Co.



has been financial adviser to municipalities and states that raise funds by issuing bonds. The company also advises cities on debt management, and through a second company, P.G. Corbin Asset Management, operates as a fixed-income manager for public, private, and philanthropic corporations. The company manages more than \$400 million in assets. Corbin has made her mark with a number of firsts, such as first black female officer at Drexel Burnham Lambert in 1982 and the first black female Alfred P. Sloan Fellow to graduate from MIT's Sloan School of Management.

B2 systems, which could benefit from LCL." . . . Albert J. Nash, SM '54, writes: "I am an associate professor at Hofstra University and consultant to Educational Technology, Inc. I have five grandchildren and would like to share notes with classmates." . . . Jerry L. Johnson, SM '83 is a senior VP of Safeguard Scientifics, Inc. . . . Mel Copen, '58, SM '59, of Cumming, Ga., writes: "After three years as dean of the Graduate School of International Management of the International University of Japan, my wife, Beverly, and I returned to Atlanta in 1994 to continue building our travel, marketing, communication, and business development company, mbGlobal Enterprises Corp. Our operations include educationally oriented tours to build international understanding and special niche markets including travel for the disabled (one of two travel organizations recognized by the Paralympics) and for health and fitness. With the pull of academia still strong, I joined the American Graduate School of International Management (Thunderbird) as the senior VP for academic affairs in September. It's a wonderful institution that has been a pioneer in the movement to globalize business management and is on the leading edge of international management education. We are enjoying the Phoenix area, but with Beverly looking after the business in Atlanta, our lives seem to revolve around long-distance commuting. The Internet is great, but . . ." . . . Ed Weisberg, SM '81, and Diane Metzger happily announce the birth of Suzanne Metzger Weisberg on November 7, 1995. Ed, Diane, 7-year-old Jake, 2-year-old Else, and Suzanne live in Sudbury, Mass.

Weisberg is a partner with Paradigm Management Group, Inc., developing and implementing innovative sales-growth programs for middle-market companies. . . . Richard S. Bodman, SM '61, AT&T's senior VP for corporate strategy and development since 1990, retired from the company in April to become managing general partner of a new venture capital fund, AT&T Venture Fund II. Before joining AT&T, Bodman was president of Washington National Investment Corp., the U.S. arm of a London merchant banking firm specializing in acquisitions of medium-sized businesses. . . . The Private Sector Council (PSC) has welcomed Robert Musser, SM '64, as its new project director. Musser joins PSC after 29 years with Mobil Corp., from which he recently retired as controller. As project manager, Musser will oversee all projects performed by PSC for federal departments and agencies and is the principal point of contact between the federal executives and PSC. Prior to joining Mobil in 1966, he worked for two years with the Nigerian government in Kaduna, Nigeria. Musser earned a BS in physics from Grinnell College. He resides in Virginia with his family.

Last year, the Free Press published *Microsoft Secrets—How the World's Most Powerful Software Company Creates Technology, Shapes Markets, and Manages People* by Associate Professor Michael Cusumano at the Sloan School and Richard Selby of UC/Irvine. According to *Business Week*, the book "provide[s] a thorough analysis of the whys and wherefores of Microsoft Corp.'s huge success." The result is "a blueprint not only for software companies, but also for any company

that's facing fast-paced markets and harrowing competition while managing a nonconformist, high-IQ staff."

SLOAN FELLOWS

James F. McNulty, SM '85, was named president of Parsons Infrastructure & Technology Group, Inc., a recently formed global business unit of the Parsons Corp., one of the world's largest full-service engineering and construction organizations. McNulty, based in Pasadena, Calif., is responsible for the new unit's



James McNulty

worldwide activities, as well as maintaining its state-of-the-art technology and resource capability. Parsons Infrastructure & Technology consolidates all of the engineering and construction firm's environmental, aviation, infrastructure, government, and industrial capabilities under a single unit. He has more than 25

years of experience in technical direction, management, and implementation of large engineering, construction, and R&D programs. McNulty earned a BS in engineering from the U.S. Military Academy and an MS in nuclear physics from Ohio State University. . . . The Association of Alumni and Alumnae was notified that Merrill Lawrence Duxtader, SM '71, of Fairport, N.Y., died on December 8,



Moving?

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1995. He was VP for manufacturing operations at Sentry Group. No further information was provided.

SENIOR EXECUTIVES

Monsanto Co.'s board of directors named Philip H. Brodsky, '88, corporate VP. Brodsky directs a range of research activities, including chemical process development, environmental technology development, and advanced analytical technology. Brodsky joined Monsanto in 1968 at the company's Indian Orchard facility in Springfield, Mass. During his research career, Brodsky played a key role in developing several new products and manufacturing processes for resins and plastics products. . . . Pugh Sugiharto, '91, of White Plains, N.Y., writes: "I am the VP for exploration and technology at PT Caltex Pacific Indonesia, an oil company jointly owned by Chevron and Texaco, producing at a daily rate of 750,000 barrels. After spending one year with Texaco, I began a second year with Chevron in May. I am exposed to issues such as corporate planning, corporate overview, public relations, finance, legal, environment, quality, etc."

MANAGEMENT OF TECHNOLOGY

David Birnbach, SM '89, now works for ONYX Software, which offers a product that manages customer contact data. . . . Takahiro Oikawa, SM '91, was at Sloan as one of the Yazaki representatives for the March meeting of the International Center for Research on the Management of Technology (ICRMOT). . . . Also in town for the ICRMOT meeting was Yuko Watanabe, SM '95, of NEC. While here, Yuko had dinner with Harriett Cohen, SM '95. . . . David P. Mattis, SM '92, is the manager of materials engineering at the General Motors Engineering Center. . . . Sigmund Kvernes, SM '93, is working on the business development of health care companies in his new position as second-in-command of a new company within the SINTEF Group. He and Anne vacationed with Alicia and Hector Pro, SM '93, in Mexico. The Kvernes have also visited MOTs in Japan. . . . Toshiharu Aoki, SM '94, met with current MOT Hiroaki Itakura in Tokyo this January, to catch up on "recent MOT life in Boston." Toshi says that he and his wife, Yoko, would like to attend the Olympic Games in Atlanta this summer.—MOT Program, MIT, Room E52-126, Cambridge, MA 02139; e-mail: <mitmot@sloan.mit.edu>

XVI AERONAUTICS AND ASTRONAUTICS

Richard J. Schulte, SM '64, president and CEO of International Approval Services in Cleveland since 1993, has been elected to a three-year term on the American Society for Testing and Materials board of directors. After receiving a BS in electrical engineering, Schulte served as an officer in the U.S. Air Force for seven years. He then worked in management consulting for much of his career until he became senior VP of the American Gas Association Labs in Cleveland, where he continues in that capacity. He has concentrat-

ed in consulting activities related to the planning, operation, and management of electric and gas utilities; the management of research programs for the electric and gas utility industry; and the management of testing laboratories for military weapons, electrical equipment, and gas appliances.

Edwin N. Myers, SM '61, writes: "I am serving as an adjunct research staff member in the science and technology division of the Institute for Defense Analyses in Alexandria, Va. . . . Marine 2nd Lieutenant Jason R. Maddocks, SM '95, recently graduated from the Basic School. The course includes instruction on land navigation, marksmanship, tactics, military law, personnel administration, Marine Corps history and traditions, communications, and the techniques of military instruction. . . . Robert A. Summers, SM '46, writes: "I retired in November from the U.S. Arms Control & Disarmament Agency after 27 years of government service in NASA, DOE, DOD, and ACDA. I have since established a consulting firm, Technology & Systems International, that focuses on defense conversion in Russia and China and technical program management." . . . Jerold P. Gilmore, SM '67, writes: "I recently retired from the C.S. Draper Lab as director of the Space Programs Office. I have formed a consulting company, Systems Engineering Solutions, Inc., in Wellesley, Mass."

Jim Marsteller, SM '47, reports: "My new grandson, Robert James 'Robbie' Marsteller, was born in August. I volunteer at the St. Louis Science Center and Wings of Hope. The latter reconitions used airplanes and makes them available to medical missionaries in Central and South America, Africa, and Asia." . . .

George Chamberlain Duncan, SM '47, a retired Navy captain who shot down several Japanese aircrafts during World War II as a double ace aviator, died December 15 after a heart attack. He lived in McLean, Va. Duncan, a native of Tacoma, Wash., entered the U.S. Naval Academy in 1935 with a zest not only for flying but also for the technical side of aeronautics. His aerial exploits during World War II earned him the Navy Cross, the Silver Star, 7 Distinguished Flying Crosses, and 15 Air Medals. During later Navy assignments in Washington, he took law courses at George Washington University. Retiring from the Navy in 1968 after 33 years of service, Duncan received a law degree from George Washington the following year and practiced in Arlington, Va. He traveled all over the world with the Shillelaghs Travel Club of Vienna.

The Association of Alumni and Alumnae was notified that Paul Vernon Osburn, SM '59, ScD '62, of Riverside, Calif., died on February 19, 1994. He was the head of the West Coast office of Charles S. Draper Labs, Inc.

XVII POLITICAL SCIENCE

Patrick O'Heffernan, PhD '89, of Atlanta, Ga., writes: "I was nominated for two Emmys and won one for my production of 16 one-minute spots for the U.N. Conference on Population. Those same spots earned me three Telly awards for the best public service

announcements of 1995." . . . Richard Sclove, SM '78 (XXII), PhD '86, of Amherst, Mass., writes: "I am the founder and executive director of the Loka Institute, a non-profit organization concerned with the social and political effects of science, technology, and architecture. My new book, *Democracy and Technology*, has just been published by Guilford Press of New York."

XVIII MATHEMATICS

Benjamin Kuipers, PhD '77, writes: "I am a professor of computer science at the University of Texas/Austin, doing research in artificial intelligence. My book, *Qualitative Reasoning*, was published in 1994 by the MIT Press. I live in Austin with my wife and three kids." . . . Larry Shiller, SM '75, is president and CEO of the Bureau of Electronic Publishing, Inc., a CD-ROM publishing company which he founded in Parsippany, N.J., in 1988. Last year, the company went public. The Bureau today has 23 CD-ROM titles, including *Monarch Notes*, *Great Literature Plus*, *Multimedia World History*, *Multimedia US History*. Most recently, the company launched *Everything Weather*, a CD-ROM done in conjunction with the Weather Channel. The Bureau received *Byte* magazine's Orchard Award for its "pioneering efforts in making CD-ROM available to end-users," and in 1992, Shiller was honored with the Optical Publishing Association's Award for Entrepreneurial Excellence.

XXII NUCLEAR ENGINEERING

Craig A. Chambers, SM '75, writes: "Since moving from Boston to Columbus, Ohio, in 1992, I've been part of the management consulting group at Battelle Memorial Institute, the world's largest independent R&D organization. In October, I was appointed VP and managing director, with the challenge to pull together the various business consulting activities at Battelle and grow consulting into a world-class competitor in the management consulting field."

David G. Adler, SM '60 (X), SM '60, is currently senior project manager of the power generation group at Babcock & Wilcox. . . . Navy Lieutenant (j.g.) Carlos D. Flores, SM '94, recently graduated from the Submarine Officer Basic Course.

XXIV LINGUISTICS AND PHILOSOPHY

Theodora J. Kalikow, SM '70, has been the president of the University of Maine/Farmington since July 1994. She received an AB in chemistry from Wellesley, and a PhD in philosophy from Boston University. During 1967-68, she was a tutor in philosophy at the University of Exeter, England. In 1968, she began teaching at Southeastern Massachusetts University (now UMass/Dartmouth), where she attained the rank of professor and served as department chair and faculty union presi-

dent. In 1981, she became the interim assistant to the president at Southeastern Massachusetts University, and during 1983-84, she served as an American Council on Education Fellow at Brown University.



Theodora J. Kalikow

From 1984 to 1987, she was the dean of the College of Arts & Sciences at the University of Northern Colorado. In 1987, she moved to Plymouth State College in New Hampshire, where she served as dean (with one year as interim president) until 1994.

TPP TECHNOLOGY AND POLICY PROGRAM

Tapio Kuusinen, '78 (I), SM '79, is working on environmental software for the U.S. textile industry and environmental auditing (without software) for the Italian national electric utility. Tapio admits it's an odd combination and he hasn't figured out a connection between the two projects yet. . . . Newton de Castro, SM '81, PhD '83 (XIII), is a professor at the Universidade de Federal in Rio de Janeiro. . . . John Newman, SM '82, is an administrator in the energy conservation and efficiency division of International Energy Agency/OECD. . . . Philippe Delquie, SM '86, PhD '89 (I), is an assistant professor at École Normale Supérieure in Cachan, France. . . . Seth Tuler, SM '87, is working with the Social and Environmental Research Institute. He just received a doctorate from Clark University in the Environment Science and Policy Program. . . . Jason Johnston, SM '88, is currently working in the Health Sciences Group at EA Engineering, Science and Technology, Inc. as a scientist III. A major portion of their work is human health risk assessments at DOD facilities. They are also involved in other projects for private clients in which toxicology, environmental exposures, and regulations overlap. . . . Simon Stokes, SM '88, moved back to London in March to join the international corporate law firm of Allen & Overy.

Abyd Karmali, SM '90, is spending the next six months in Paris working at the U.N. Environment Program. . . . Jerry Sheehan, '86, SM '91, joined the computer science and telecommunications board at the National Research Council last September. . . . Marguerite "Anne" Wagner, SM '91, is currently working on air pollution compliance at Madison Gas & Electric. . . . Frank Gillett, SM '92 (XVII, TPP) and Kim Motylewski are planning an August wedding.

Lola Matysiak Lohr, '91 (I), SM '92, has joined Oracle Corp. as a senior consultant. She is enjoying married life and living in Colorado. . . . Karen and Michael Rookwood, SM '92 (II, TPP) are looking forward to the birth of their first child in July. . . . Also expecting their first child in July are Monica Becker, SM '94, and Edieal Pinker. . . . Paola and Juan Pablo Montero, SM '94, are expecting their second child. Isabella is looking forward to

CourseNews

being an older sister. . . . Ulrich Knirsch, SM '95, has been working with Booz Allen & Hamilton's aviation practice since November 1995. Most of the work centers around satellite navigation. Uli informs us that a TPP perspective really helps to understand complex and international systems.

Christine and Alexis de Pommerol, SM '95 (I, TPP) and are pleased to announce the birth of daughter Agatha on January 8. . . . Philip Byer, '70 (VI), SM '72 (I), PhD '75 (I) (TPP Friend) is chair of the new division of environmental engineering at the University of Toronto. . . . Takeshi Yajime (TPP Friend) is the deputy-director general of the city bureau in the Ministry of Construction in Japan.—Richard de Neufville, TPP, MIT Room E40-252, Cambridge, MA 02139; e-mail: <ttp@mit.edu>

Deceased

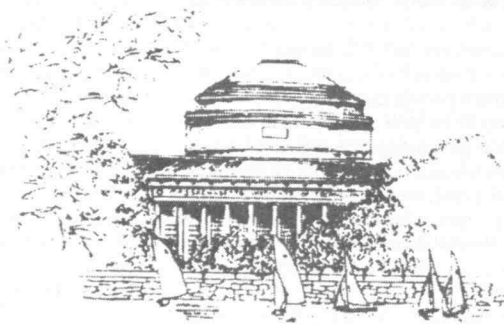
The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

John Byron Ingle, SM '16; February 25, 1975; Long Beach, Calif.
Benjamin Fisher, '21; February 9, 1996; Walpole, Mass.
Howard George Doster, '23; September 17, 1995; Medford, N.J.
Thomas Nelson, '25; January 20, 1996; Clearwater, Fla.
Walter John Rhodes, '25; January 29, 1996; Lewisburg, Pa.
George Warren Bates, '26; November 29, 1995; Durham, N.H.
James Francis Carey, '26; June 11, 1995; Wallingford, Pa.
James Orr Crawford, '26, SM '27; August 1, 1995; Rydal, Pa.
Albert Freeman Kinzey, '26; October 2, 1995; Stockton, Calif.
Lauritz Herman Rasmussen, '27; November 12, 1995; Quincy, Mass.
Elisha Gray, '28; February 27, 1996; Benton Harbor, Mich.
Julian Werner Hill, PhD '28; January 28, 1996; Hockessin, Del.
Maxwell Parshall, '28; January 30, 1996; Hamilton, Mont.
Adrian Nash Clark, '29, SM '32; December 4, 1995; Woodbury, Conn.
Richard Nelson Chindblom, '30; July 2, 1995
Constantine John Orfanos, '30; December 5, 1995; Carmichael, Calif.
Ralph Hyde Swingle, '30; January 3, 1995; Fort Lauderdale, Fla.
Boyd Bertrand Brainard, '31; October 19, 1995; Sun City, Ariz.
Donald Archer Holden, '31, SM '31; November 12, 1995; Charlottesville, Va.
William Bernard Littreal, SM '31; March 14, 1995; Roanoke, Va.
William F. Robinson, '31, SM '32; May 21, 1995; Houston, Tex.
Kenneth Edward Wischmeyer, MAR '31; January 16, 1996; Saint Louis, Mo.
Lawrence Charles Henry Berk, '32; December

- 29, 1995; Boston, Mass.
Frank Sprague Chaplin, '32; February 2, 1996; Blounts Creek, N.C.
Willard Haskell Foster, '32; January 9, 1996; Chatham, Mass.
William Ennis Skelton, SM '32; July 20, 1995; Nederland, Tex.
Raymond Kermit Thompson, SM '32; November 13, 1995; Vancouver, Wash.
Adolph Isaac Warsher, '32, SM '34; March 25, 1995; Dedham, Mass.
Frank Joseph Bleil, '33; December 28, 1995; Visalia, Calif.
Alfred Peter Bruce, '33; November 27, 1995; Salem, Va.
George Richards Churchill, '33; November 8, 1995; North Weymouth, Mass.
Norma Koch, MPH '48; December 1, 1995; Turners Falls, Mass.
John Ivers Lynch, '33; September 23, 1995; Winchester, Mass.
Elna Iris Perkins, '33; October 6, 1995; Concord, N.H.
Hal Lawall Bemis, '35; March 7, 1996; Haverford, Pa.
Robert Goodhand Clarke, '35; June 11, 1995; Auburndale, Fla.
Thomas William Hafer, '35; August 6, 1995; Honolulu, Hawaii
Charles William Smith, '35, SM '36; October 9, 1995; Raleigh, N.C.
Eoin MacDonald Nyhen, '36; November 30, 1994; Arlington, Va.
Roy G. Thompson, '36; September 18, 1995; Boynton Beach, Fla.
Mark Newton Curgan, '39; January 26, 1996; Greenville, S.C.
Benjamin Leonard Krause, '39; January 31, 1995; Jaffrey, N.H.
John Thomas Massengale, PhD '39; October 11, 1993; West Chester, Pa.
Fred John Johnson, '40; December 2, 1995; Englewood, Fla.
William Wooster Merrill, '40; March 10, 1996; Camarillo, Calif.
M. Wayne Stoffle, MAR '40; January 10, 1996; Metairie, La.
James John Holley, '41; November 24, 1995; Farmington Hills, Mich.
Rene Henri Bourguet, '42; April 29, 1993; Manhasset, N.Y.
Harry Grover Clarke, '43; December 21, 1995; Lancaster, Pa.
Dexter Kingsbury Bowers, '43; September 15, 1995; Essex, Conn.
Alvin Clark Brodie, '43, '47, SM '48; November 1, 1995; Dover, Mass.
Arthur Kenworthy Hoge, '44; October 19, 1994; Bristol, Conn.
James E. St. Germain, '44; January 14, 1996; Phoenix, Md.
Juan Andres Vegas, '45; August 4, 1992; Caracas, Venezuela
David Allmond Kleinman, '46, SM '47; March 23, 1988; High Bridge, N.J.
Joseph Michael Donahue, '47; November 28, 1995; Milton, Mass.
William Albert McKinley, PhD '47; December 15, 1995; Altamont, N.Y.
G. Fred Dunmire, '48; March 24, 1995; Centerport, N.Y.
Clifford Carmichael Ham, '48; September 9, 1995; Pittsburgh, Pa.
John Thomas Reid, '48; July 31, 1994; Schenectady, N.Y.
Clinton Oscar Chichester, '49; November 12, 1995; Wakefield, R.I.
William Seneer Lewis, '49; SM '50; November 10, 1995; Cornish, N.H.
Joseph Aaron Stern, '49, SM '50, PhD '53; January 31, 1996; Hampton, Va.
Edward Beale Wilson, '49; April 9, 1995; Jackson, N.H.
Marlin Claude Hydinger, SM '50; December 11, 1995; Jacksonville, Fla.
Allan Elston, '51; January 15, 1996; Chicago, Ill.
Herbert Henry Dow, '52; January 26, 1996; Midland, Mich.
William Isedore Goodman, MCP '52; December 23, 1995; Urbana, Ill.
Richard Edward Lyle, '52; November 12, 1995; Oakland, Calif.
George Deardon Stevenson, '53; September 13, 1994; Orlando, Fla.
Arthur Martin Vash, SM '53; November 13, 1995; Westwood, Mass.
Gustav Solomon, PhD '56; January 31, 1996
Paul Marshall Nathan, '57; October 15, 1995; Ashland, Mass.
Wayne Richard Chiodi, '64; March 7, 1996; Northbrook, Ill.
David Edmund Hodges, '71; December 15, 1995; Santa Rosa, Calif.
Leon K. Kirchmayer, '75; November 12, 1995; Rexford, N.Y.
Kevin John Lehnert, '86, SM '86; January 21, 1996; Garland, Tex.
Anthony David Sykes, '93; February 21, 1996; New York, N.Y.
Anya Pogoyants, SM '95; December 15, 1995; Mountain View, Calif.
Melissa N. Ronge, '98; February 26, 1996; N. Syracuse, N.Y.



HERE MIGHT A NAME BEST LIVE?



The name of a deceased MIT alumna or alumnus can be linked to the Institute through gifts made by classmates, colleagues and family. Memorial gifts can be unrestricted or directed toward scholarships, research or any program of the Institute. The Institute notifies bereaved families of the name of each donor, and each gift becomes a part of MIT's permanent record.

Named endowed funds whose income supports the work of the Institute in perpetuity can be established with larger gifts. If you would like information on ways of expressing sympathy through a memorial contribution, or on establishing a named endowment fund, please contact Betsy Millard, MIT Room E38-202, Cambridge, MA 02139 or call (617) 253-8059.

PuzzleCorner

Alan Faller asks a question that comes up from time to time—always worded something like “Are there (or why aren’t there) any books compiling TR puzzles?” My standard reply is that there are no copy-right problems known to me. As far as I can tell, “all” that is needed is for a potential co-author to volunteer to select problems and deal with some publisher.

It has been a year since I reviewed the criteria used to select solutions for publication. Let me do so now. As responses to problems arrive, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column in which solutions are to appear, I first weed out erroneous and illegible responses. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred, as are contributions from correspondents whose solutions have not previously appeared. I also favor solutions that are neatly written, typed, or sent via e-mail, since these produce fewer typesetting errors.

Problems

JUL 1. Somehow I forgot to include the hand with F/M 1. Not surprisingly, no one was able to solve the problem without the hand, so I am repeating the complete problem now and renaming it **Jul 1**.

In the hand below, submitted by Doug Van Patter, the bidding was short and sweet: South opened with 1H, West bid 2C, North bid 4H, and everyone then passed. How can South make the contract after opening lead of the King of Clubs?



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO: ALLAN GOTTLIEB
NEW YORK UNIVERSITY
715 BROADWAY, 10TH FLOOR
NEW YORK, N.Y. 10012,
OR TO: GOTTLIEB@NYU.EDU

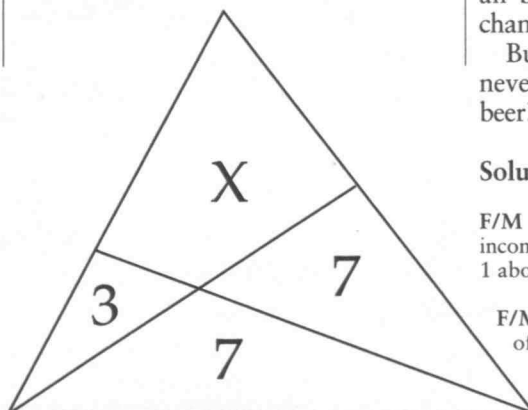
		North	
		♠	J 8 6
		♥	K 7 4
		♦	K Q 10
		♣	A 10 9 8
		East	
		♠	Q 7 5 4 2
		♥	9 8
		♦	A J 7 6 5
		♣	3
		South	
		♠	A 9
		♥	A Q J 6 5 2
		♦	9 3 2
		♣	6 4

JUL 2. Phil Bonomo seems to like “space cadet” problems, especially those involving navigation satellites. In ’93 he asked about their velocity, now he questions their altitude.

Geosynchronous orbits are generally taken to be the orbits of largest radius (highest altitude) for earth-orbiting spacecraft. These circular orbits, of radius R_s ($\approx 26,300$ miles), are characterized by a 24-hour orbital period and are typically used by the equatorial, “stationary” class of communications spacecraft. Another class of communications spacecraft (the Russian “Molniya” class) employ inclined, highly eccentric orbits characterized by a 12-hour orbital period.

For what orbital conditions, if any, is the largest (apogee) radius of a Molniya orbit greater than the synchronous orbital radius R_s ?

JUL 3. Nob Yoshigahara wants you to figure out the area of X in the figure below.



Speed Department

Here is one Steve Chilton gives his “methodology and statistics” class every year:

Around the turn of the century, back when you could still buy a 10-cent beer, a small logging town on the U.S.-Canadian border was experiencing a strange currency exchange situation. On the Canadian side of the border, a U.S. dollar was only worth 90 Canadian cents, while on the U.S. side, a Canadian dollar was only worth 90 U.S. cents. (In other words, the citizens of both countries discounted the other country’s currency by 10 percent.)

In this particular town, the international border ran right down the center of the main street, and there were bars on both sides catering to loggers from the surrounding area. One Saturday, an American logger rolled into town with little money (only U.S. \$1.00) but lots of financial cunning. He stopped at the first bar he found on the U.S. side of the street, ordered himself a 10-cent beer, paid with his U.S. dollar, and asked for a Canadian dollar in change (worth only U.S. \$.90, remember). After finishing his beer, he walked across the street to a Canadian bar, ordered another 10-cent beer, paid with the Canadian dollar, and asked for a U.S. dollar in change (there, worth only Canadian \$.90. Back he went to the American side for another beer, then back across to the Canadian side—and so on all afternoon and evening, finally staggering back to his camp after a final drink from a Canadian bar and a U.S. one-dollar bill in change—just as he had started out with.

But what his fellow loggers could never figure out was, who paid for the beer?

Solutions

F/M 1. As indicated above this problem was incomplete and the complete version is now Jul 1 above.

F/M 2. Eugene Sard begins this month’s offerings with a geometry problem. Given a triangle ABC, find a geometrical con

Continued on Page MIT 26

MIT LIFE INCOME FUNDS

MR. EDWIN G. ROOS

HOME: New York, New York

CAREER: The three important influences in Ed Roos's life are his parents, MIT and his service in the United States Army. He entered MIT with the class of 1944, and as a member of ROTC was called for active duty in April 1943. He was able to complete his junior year—his major was chemical engineering—but then left for basic training. He served in Europe as an intelligence officer and armored flame thrower specialist and was discharged in 1946 as a first lieutenant in the Armored Force Reserve. Ed returned to MIT that June and finished his degree the following January. After working two years as a petroleum engineer, he joined his father's commercial real estate firm, Williams Real Estate Co. Inc., in New York City. When Truman put reserve troops in Europe to discourage the Soviets from moving west while American forces were in Korea, Ed was called back for active duty in Germany. He returned to

Williams Real Estate after his Army discharge in 1952. Since 1980, he has been vice chairman of the board of the company that has become, under his leadership, one of New York's largest real estate firms.

Currently president of the Class of 1944, Ed has a long record of service to MIT. In 1983, he established at MIT the Sydney W. and Alma G. Roos Scholarship Fund to honor his parents and has also given generously to the MIT Libraries.

MIT LIFE INCOME FUND: The Edwin G. Roos Charitable Remainder Annuity Trusts.

QUOTE: I am proud of having served in the Army, proud of having gone to MIT, and proud that I give to MIT so others can go there too.

For more information about MIT Life Income Funds, write or call D. Hugh Darden or Frank H. McGrory at MIT, Room 4-234, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Richard Howard

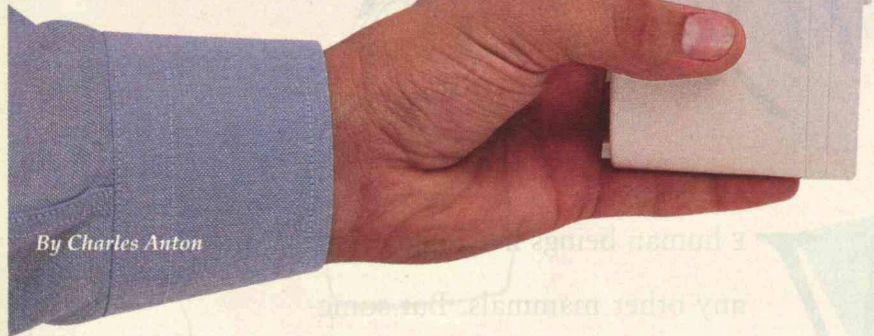


DONOR'S PROFILE

New device turns any electrical outlet into a phone jack

Engineering breakthrough gives you unlimited phone extensions without wires or expensive installation fees

By Charles Anton



You don't have to have a teenager to appreciate having extra phone jacks. Almost everyone wishes they had more phone jacks around the house.

When I decided to put an office in my home, I called the phone company to find out how much it would cost to add extra phone jacks. Would you believe it was \$158?

No more excuses.

Today, there are a thousand reasons to get an extra phone jack and a thousand excuses not to get one. Now an engineering breakthrough allows you to add a jack anywhere you have an electrical outlet. Without the hassle. Without the expense. And without the miles of wires.

Like plugging in an appliance.

Now you can add extensions with a remarkable new device called the Wireless Phone Jack. It allows you to convert your phone signal into an FM signal and then broadcast it over your home's existing electrical wiring.

Just plug the transmitter into a phone jack and an electrical outlet. You can then insert a receiver into any outlet anywhere in your house. You'll be

able to move your phone to rooms or areas that have never had jacks before.

Clear reception at any distance. The Wireless Phone Jack uses your home's existing electrical wiring to transmit signals. This gives you sound quality that far exceeds cordless phones. It even exceeds the quality of previous devices. In fact, the Wireless Phone Jack has ten times the power of its predecessor.

Your range extends as far as you have electrical outlets: five feet or five hundred feet. If you have an outlet, you can turn it into a phone jack—no matter how far away it is. The Wireless Phone Jack's advanced companding noise reduction features guarantee you crystal-clear reception throughout even the largest home.

Privacy guarantee.

You can use The Wireless Phone Jack in any electrical outlet in or around your home, even if it's on a different circuit than the transmitter. Each Wireless Phone Jack uses one of 65,000 different security codes. You can be assured that only your receiver will be able to pick up transmissions from your transmitter.

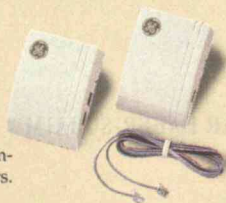
Is the Wireless Phone Jack right for you?

The Wireless Phone Jack works with any single-line phone device. Almost anyone could use it, especially if...

- **Few jacks.** You want more phone extensions without the hassle and expense of calling the phone company.
- **Bad location.** You have jacks, but not where you need them most, like in the kitchen, garage, home office or outside on the deck.
- **Renting.** You want to add extensions, but you don't want to pay each time you move.
- **Other phone devices.** You have an answering machine, modem or fax machine you want to move to a more convenient place.

The Wireless Phone Jack System

consists of a transmitter (right) and a receiver (left). One transmitter will operate an unlimited number of receivers.



Unlimited extensions—no monthly charge. Most phone lines can only handle up to five extensions with regular phone jacks. Not with the Wireless Phone Jack. All you need is one transmitter, and you can add as many receivers as you want. Six, ten, there's no limit. And with the Wireless Phone Jack, you'll never get a monthly charge for the extra receivers.

Works with any phone device.

This breakthrough technology will fulfill all of your single-line phone needs. It has a special digital interface for use with your fax machine or modem. You can even use it with your answering machine just by plugging it into the Wireless Phone Jack receiver.

Special factory-direct offer.

To introduce this new technology, we are offering a special factory-direct package. For a limited time, the transmitter is only \$49. One transmitter works an unlimited number of receivers priced at \$49 for the first one and \$39 for each additional receiver. Plus, with any Wireless Phone Jack purchase, we'll throw in a phone card with 30 minutes of long distance (a \$30 value) for only \$9.95!

Try it risk-free. The Wireless Phone Jack is backed by Comrad's exclusive 30-day risk-free home trial. If you're not completely satisfied, return it for a full "No Questions Asked" refund. It is also backed by a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

Wireless Phone Jack transmitter ...\$49 \$4 S&H
Wireless Phone Jack receiver\$49 \$4 S&H
save \$10 on each additional receiver—\$39

30-minute long distance phone card.....\$30
\$9.95 with Wireless Phone Jack purchase

Please mention promotional code 017-TO7402

For fastest service, call toll-free 24 hours day

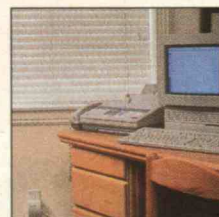
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By Steven Alan Edwards

Pork Liver, Anyone?

WE human beings live longer than any other mammals. But sometimes our organs begin to expire before we ourselves are ready to.

*Before
too long,
organs
from other
species may
routinely
replace
our own
failing
parts.*

Organ transplantation has recently become a relatively routine solution to this dilemma. Thanks to the availability of immunosuppressive drugs, organs such as hearts, lungs, livers, and kidneys can now be transplanted successfully.

Yet this has led to a new problem: a supply shortage. There simply are not enough donor organs to go around. While physicians perform approximately 20,000 transplant operations per year in the United States, 40,000 patients are waiting for organs, and that number is growing. Every year, thousands of them die while waiting for the fatal car wrecks that will provide the organs they need.

ILLUSTRATIONS BY TAMAR HABER-SCHAIM



Driven by necessity and advances in technology, scientists are turning to other species for a solution. Some are experimenting with organ grafts from close non-human relatives, such as baboons, while several biotech companies, backed by large corporate sponsors, are investing heavily in the prospect of transplanting spare parts from pigs. Once viewed as extreme and exotic, the fledgling field of xenotransplantation—the use of animal organs and tissues in human beings—is rapidly gaining credibility.

PIONEERING WITH PRIMATES

Xenotransplantation leapt into the headlines in 1984, when cardiac surgeon Leonard Bailey transplanted a baboon heart into a newborn girl known as Baby Fae, whose congenital heart deformity gave her no chance of surviving on her own. She lived for 20 days after the operation. At the time, the experiment seemed breathtakingly premature, and Bailey received considerable professional criticism for his pioneering efforts.

Nonetheless, experimentation with baboon organs continued. In less broadly publicized cases in 1992 and 1993, surgeons at the Transplantation Institute of the University of Pittsburgh Medical Center, under the direction of Thomas Starzl, transplanted baboon livers into two patients and used a combination of immunosuppressive drugs to combat rejection. One patient lived less than a month; the other lived 70 days, succumbing not to liver damage but to an unrelated brain infection. (This patient was discovered to have been HIV-positive; ironically, his faulty immune system may have helped him survive the transplant.) Based on these less than satisfactory results, the Pittsburgh team has voluntarily suspended operations. Another scientist, Robert Michler of Columbia University, has applied to his institutional review board for permission to use baboon hearts to keep patients alive until human hearts can be found.

Besides using baboon organs to replace humans' worn-out ones, doctors are experimenting with the use of baboon bone marrow to fight disease. Last December, surgeons led by Paul Volberding at San Francisco


General Hospital transplanted bone marrow from a baboon into AIDS patient Jeffrey Getty in the hope of restoring his damaged immune system. The stem cells that develop into the white blood cells of the immune system propagate in the bone marrow. Since baboons are resistant to AIDS, researchers hope that the baboon's bone marrow may produce white blood cells that can resist attacks by the AIDS virus to replace those already lost to the disease. So far the theory remains unproven, since it appears that Getty's bone graft did not take.

Getty is not the first human to receive a bone marrow transplant from a baboon. An earlier AIDS patient died two months after receiving a baboon bone marrow graft in an operation performed by a University of Pittsburgh team. Nor will Getty be the last: the Food and Drug Administration has authorized the bone marrow treatment for four more patients.

Bone marrow transplants may also pave the way for transplants of other organs. Normally, transplanted organs are subject to rejection because the host immune system recognizes antigens on the surface of the donor cells as foreign and attacks the foreign cells.

To prevent rejection, organ recipients must undergo lifelong treatment with immunosuppressive drugs, leaving them vulnerable to opportunistic infections and malignant tumors. Transplanted bone marrow, however, appears to be able to teach the host immune system to recognize antigens on the surface of its cells as "self" rather than other. Susan Ildstadt of the University of Pittsburgh has discovered cells in the bone marrow, called facilitator cells, that apparently communicate this information to the rest of the immune system. The result is what Ildstadt terms "donor-specific tolerance": once the immune system recognizes the bone marrow as "self," it will recognize and tolerate other organs with the same antigens and therefore will not attack subsequent transplants from the same donor.

An occasional collaborator of Ildstadt's, David Sachs of Harvard University Medical School, has used bone-marrow grafts from one monkey to another to forestall rejection of other transplanted organs from the same donor. At the same time, the host monkeys remain competent to reject third-party organ grafts, indicating that their immune systems are still functioning correctly. So far, the monkeys have survived more than two years. Based on these results, Sachs hopes to use the procedure to facilitate transplants between different species.


With
*advances in
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problem.*

STEVEN ALAN EDWARDS, a former research scientist in molecular genetics and developmental biology at the Salk Institute's La Jolla Cancer Research Foundation, is presently a freelance writer based in Nashville, Tenn.

The prospect of successful transplants from other primates to humans has aroused opposition from an unlikely coalition of virologists, ecologists, bioethicists, and animal rights activists. First, all primates are fairly intelligent animals; many activists argue that other primates have as great a right to life as human beings. Second, if the operations do succeed on a regular basis, the entire world population of baboons would not be sufficient to fill the need for organ donations for a single year. And since baboons do not breed much faster than we do, there is no easy way to boost the supply. Third, and most problematic for humans, other primates carry viruses and other pathogens that might, through the transplant patient, break the species barrier and infect human populations. According to Louisa Chapman, an epidemiologist for the federal Centers for Disease Control, animals can transmit more than 150 known diseases to people. Some, such as rabies or the hemorrhagic fever caused by the Ebola virus, are more dangerous to humans than to their natural host.

The greatest fear is another pandemic like AIDS. HIV, the virus that causes AIDS, is thought to have originated among nonhuman African primates. Various medical horror stories, none proven, have sprung up to explain how the species jump might have occurred. One suggests that the original monkey virus may have been a contaminant of early polio vaccines tested in Africa. (Poliovirus used for vaccines was harvested from green-monkey cells cultured in laboratories.) But scientists testing some of the remaining samples of the implicated vaccine have found no evidence of contamination. A less well publicized but somewhat more plausible explanation traces the alleged crossover to experiments during the 1950s, in which physicians injected chimpanzee serum into human beings in a misguided attempt to transfer resistance to malaria. According to this scenario, the virus spread from other primates to humans by the same method—blood-to-blood transmission—by which it has since disseminated through the human population.

The threat posed by HIV may be far from unique. HIV is a retrovirus, a type of virus that can integrate its genes into the host's chromosomes. All mammalian species seem to contain at least a few retroviruses per-

manently encoded in their genome that are transmitted from generation to generation. The mouse, a species that has been extensively studied, carries hundreds of retrovirus-related gene sequences, sometimes including genes that cause leukemia or breast cancer.

Indeed, some mouse retroviruses are called "xenotropic" because they seem to propagate better in animal species other than mice. Mouse xenotropic viruses become activated when mouse cells are cultivated with mink or rat cells, for example. Baboons similarly carry a virus called baboon endogenous virus (BEV) that can infect human cells in culture, according to Jonathan Allan, a virologist and AIDS researcher at the Southwest Foundation for Biomedical Research. BEV causes the baboon no great problem, but its effect on human beings is an experiment that nature hasn't yet performed. Baboons also frequently carry simian foamy virus, another asymptomatic retrovirus, and almost all are infected with at least one of the three known baboon variants of herpes.

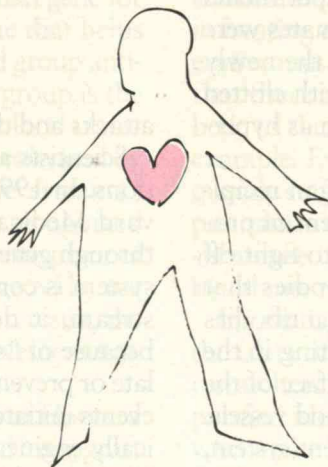
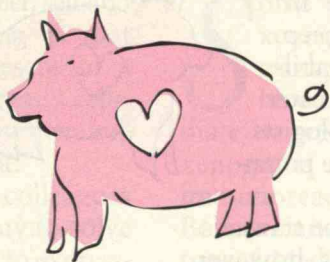
"If the federal health agencies are really serious about protecting the public," Allan wrote in a recent New York Times editorial, "we would not permit even one more baboon transplant."

To scientists such as Allan, experimental bone marrow transplants like Getty's pose the danger of transmitting primate viruses to people. Not only is the AIDS patient's immune system compromised as a result of the disease, but he or she takes immunosuppressive drugs as well and thus is doubly at risk for opportunistic infections. If the baboon harbors a virus that can infect humans, the patient will have little chance of fighting off infection, and could pass the virus on to other people.

THE CASE FOR PIGS

If pigs could be used as a source of organs for people, many of the logistical, ethical, and public health concerns about xenotransplantation would vanish. Pigs will never be an endangered species, and they breed much faster than primates. Some 93 million pigs a year are slaughtered in the United States for meat, and all but the most zealous of animal rights activists would likely accept a few thousand more porcine deaths in exchange for human life.

Most important, scientists are far less concerned



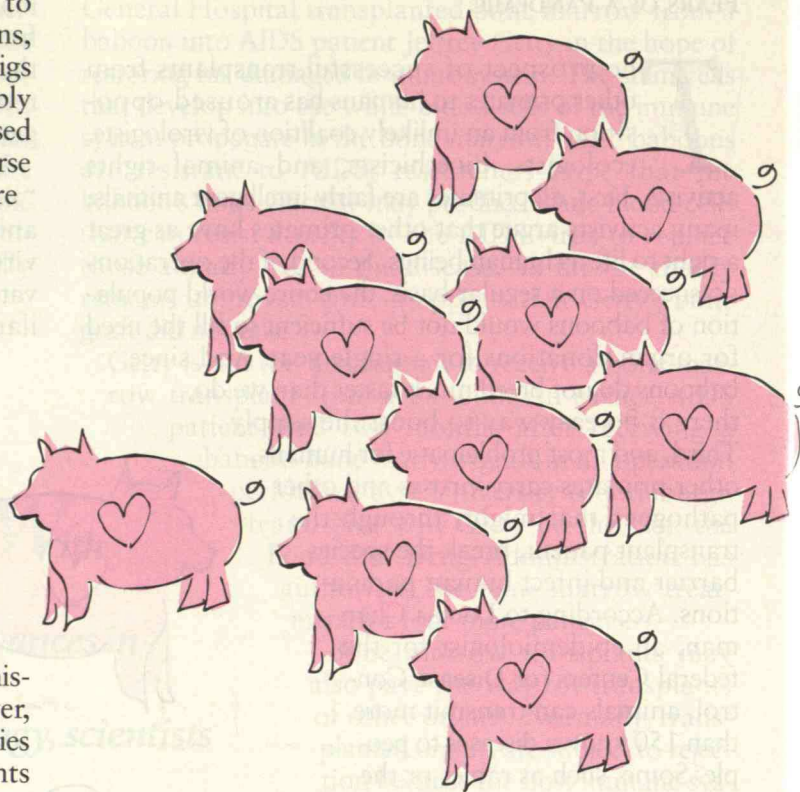
about the prospect of pigs transmitting illnesses to humans. Pigs do not harbor many human pathogens, and since humans have lived in close proximity to pigs for centuries, most potential pathogens have probably been recognized. Indeed, pig heart valves have been used in humans for more than 20 years without any adverse effects. Primates, by contrast, are at once much more closely related to humans, making species-to-species transmission more likely, and much more alien to us—the two species have never lived side by side.

New viruses transmitted from domesticated animals to humans do emerge periodically, such as the famous “swine flu” epidemic during the 1970s, or more recently the outbreak of Creutzfeldt-Jakob (“mad cow”) disease in Britain, believed to be transmitted from sheep to cows to humans. But although the probability of a devastating pandemic is certainly “greater than zero,” as one scientist put it, even virologists like Allan are relatively sanguine about the potential risks of pig-to-human transplants.

The genetic distance that helps prevent the transmission of diseases between pigs and humans, however, poses a problem in transferring organs from one species to the other. Early xenotransplantation experiments involving grafts from pigs to nonhuman primates were spectacularly unsuccessful. Within minutes, the newly grafted organs shriveled and turned black with clotted blood. The problem is a phenomenon known as hyperacute rejection.

Hyperacute rejection occurs when the organ recipient's antibodies activate a complicated system of proteins called “complement” that has evolved to fight off viral and bacterial infections. Unlike antibodies that form in response to a specific infection, the antibodies that trigger this reaction are already circulating in the bloodstream. They immediately coat the surface of the endothelial cells that line the new organ's blood vessels. The bound antibodies activate the complement system, which releases a series of enzymes that digest proteins. Some essentially drill holes in the endothelial cells; others cleave strands of fibrinogen, a protein in the blood, so that the strands cross-link and form blood clots around the damaged cells, choking them. The transplanted organs die before they have the chance to fulfill their life-giving function.

Even if hyperacute rejection were averted, the transplanted organ would still be subject to a process known as “delayed xenograft rejection,” which occurs over a period of days or weeks and, paradoxically, is initiated by the graft itself. When the blood vessels of the transplanted organ are severed and then reattached, the endothelial cells respond to the injury by activating genes that invite inflammation and blood clotting—in effect, sending out a call to the host body's complement and immune systems for help. But alerting the complement system backfires: instead of repairing the injury, it



attacks and ultimately destroys the foreign organ.

Scientists are looking for ways to prevent these reactions. In 1991, Fritz Bach and Gus Dalmasso of Harvard Medical School proposed solving this problem through genetic engineering. Although the complement system is continuously activated in the human bloodstream, it does not normally attack our own cells because of “shield proteins” on cell surfaces that regulate or prevent specific steps in the cascade of destructive events initiated by complement. If a pig could be genetically engineered to express these human complement-inhibiting shield proteins, then pig organs might escape hyperacute rejection in pig-to-human transplants.

ENGINEERING THE PIG—OR PATIENT

Bach and Dalmasso's suggestion has spawned an industry that might be called organ farming. The first pig engineered to produce human shield proteins, a sow named Astrid, was born on December 23, 1992, to the proud researchers at Imutran, a biotech company in Cambridge, England. Another firm, Nextran, now a Baxter Laboratories subsidiary located in Princeton, N.J., has also bred a herd of pigs that express human shield proteins. Both companies' pigs are now being used in xenotransplantation experiments involving pigs and monkeys.

While organs from the two companies' transgenic pigs may escape hyperacute rejection, they may

nonetheless succumb to delayed xenograft rejection.

According to Stephen Squinto of Alexion Pharmaceuticals in New Haven, Conn., 90 percent of the antibodies that initiate complement-mediated rejection in primates target a single antigen that

is present in pigs and in nearly every other species—except

Old World monkeys and higher primates, including humans. The antigen is

therefore a useful marker that allows primate immune systems to distinguish between self and other. As long as that

antigen is present in a transplanted organ's cells, the complement system will eventually attack it.

Squinto and his colleagues have figured out a way to solve this problem. In addition to expressing genes for human shield proteins, Alexion's pigs express the human gene for

H-transferase, an enzyme that helps create human O-blood group antigens. (The O-blood group is the universal donor in blood transfusions because it is tolerated by all human immune systems.)

This universally recognized human antigen takes the place of the porcine antigen targeted by the

xenoreactive antibodies. As a result, the transplanted organ will not alert the complement system to attack.

Meanwhile, Fritz Bach and his colleagues at Harvard Medical School are trying to avert delayed xenograft rejection by inhibiting expression of the genes that call for help from the immune and complement systems. This will not necessarily be good for the pigs—it may leave them vulnerable to injury and infection—but through the extraordinary care lavished on these expensive creatures, scientists hope to keep the ill effects to a minimum.

Bach's job would be made easier if he could simply eliminate some of the genes he has identified as triggering xenograft rejection. In mice, researchers use a process known as homologous recombination to knock out unwanted genes. The process involves removing stem cells from the mouse embryo, growing them in the laboratory, engineering them, and injecting them back into the embryo. Scientists have not yet succeeded in growing embryonic pig stem cells in the laboratory, but biotech firms are working hard on the technology.

While Imutran, Nextran, and Alexion are modifying

the pig to be a more acceptable organ donor, a third firm, Biotransplant, is pursuing a different approach: modifying the patient to accept pig organs more readily. Under the direction of Harvard's Sachs, the company's researchers hope to isolate immune system stem cells from the patient's bone marrow and genetically engineer them to express pig tissue compatibility markers. These engineered stem cells would be reintroduced to the host before the organ transplant. In effect, these cells would teach the immune system to regard pig cells as identical to self.

PREFERRED MARKETS

Some researchers argue that cell and tissue xenografts are more likely to be successful than transplantation of solid organs. Lacking the blood vessels and endothelium that are the immediate targets of hyperacute rejection, cell and tissue xenografts are less likely to elicit as powerful an immunoreactive response. Norman Levinsky of the Boston University Medical Center, who chairs an Institute of Medicine (IOM) committee formed to investigate the scientific basis for xenotransplant research, stresses the potential value of cell and tissue xenografts in treating diabetes, Parkinson's disease, and the degenerative muscle disease myasthenia gravis. He points out that there are 10 times as many people who are diabetic as there are on organ-transplant waiting lists, for example. Even when treated with insulin, diabetics frequently suffer from blindness, circulatory problems, and premature death. A daily shot of insulin is not a good substitute for endocrine cells that can respond minute by minute to physiological changes.

Insulin is ordinarily produced by specialized cells in the islets of Langerhans within the pancreas. Medical researchers have been experimenting with transplanting purified islets from ordinary pigs into diabetic patients, who make better subjects for testing xenotransplantation procedures than heart or liver patients because the transplant does not have to be life-sustaining: the patient can be maintained on insulin while the graft is given a chance to work. A Swedish group has transplanted nontransgenic porcine pancreatic islets into eight patients who were receiving immunosuppressive drugs for other conditions. Insulin peptides secreted by the transplanted tissue were detected up to a year after the operation. The transgenic pigs being developed may prove to be a better source from which to isolate islet cells because they express human shield proteins.

Scientists studying Parkinson's disease are now treating patients experimentally with brain tissue from aborted human fetuses, a practice that is at least as controversial as xenotransplantation. Fetal transgenic pigs may be a more reliable and palatable source of tissue for these patients. Myoblast cells from transgenic pigs or other animals may eventually be used to

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an endangered

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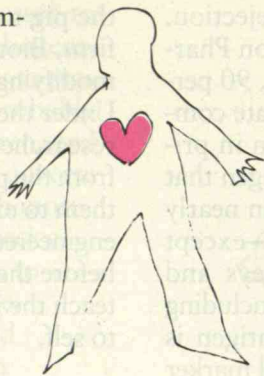
treat patients with myasthenia gravis, a comparatively rare disease.

Of these groups, only diabetes patients represent a potentially large market, and they are already served—if imperfectly—by existing treatments. As a result, big corporate investors are bypassing research on cell and tissue xenografts and underwriting research on whole-organ transplants instead. Baxter Healthcare Corp., a major conglomerate, recently bought the 30 percent of Nextran that it did not already own. U.S. Surgical, a leading surgical instrument supplier, owns an equity interest in Alexion and has acquired exclusive rights to market the company's transgenic pig organs. The giant Swiss corporation Sandoz Pharma supports research at Imutran and Biotransplant and also funds an academic arm, the Sandoz Center for Immunobiology headed by Harvard Medical School's Bach.

Corporate investors argue that if pig-to-human transplants become a reality, the increased supply of organs could dramatically boost the number of transplants being performed. Peter Laing, a financial analyst at Salomon Brothers, projects that 250,000 xenotransplant operations will be performed annually by the year 2010. He cites estimates that as many as 400,000 patients in the United States are newly diagnosed with congestive heart failure each year. As many as 70,000 of these people will die without transplants; many more might benefit in terms of quality of life. Yet only 2,300 heart transplants were actually performed in 1994. Similarly, many patients now undergoing hemodialysis would be better served by kidney transplants. For the companies that market transgenic organs—and the immunosuppressive drugs needed to tolerate them—the potential profits could be tremendous.

MAKING XENOGRAFTS A REALITY

The first milestone on the road to routine xenotransplantation will probably be the use of transgenic pig livers in humans. The Food and Drug Administration (FDA) has approved a phase I trial in which livers from Nextran's pigs will be used as a bridge to support patients with liver failure. The trials will be conducted at Duke University Medical Center under the direction of surgeon Jeffrey Platt.



Industry

*researchers expect
human trials of
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Historically, the FDA has not passed judgment on xenotransplant procedures (Jeffrey Getty's surgeons sought it voluntarily). But in the wake of concern about the potential transmission of pathogens across species, the FDA has now begun to assert authority over transplanted cells and tissues as well as transgenically altered organs. Together with the Centers for Disease Control and the National Institutes of Health, the agency is expected to publish guidelines regulating xenotransplantation later this year.

The liver may seem an unlikely candidate for successful xenotransplantation. It functions as the body's detoxification center and is the principal organ responsible for maintaining blood sugar. It also supplies the albumin that makes up more than half of the protein in the blood. A patient with a transplanted pig liver—transgenic or otherwise—would have porcine serum albumin in his or her blood instead of the human equivalent, perhaps stimulating the patient's immune system to reject it. Moreover, pig livers may not even recognize some of the hormones that govern the functioning of the human liver. And even if they do, no one knows whether the blood sugar level that a pig liver produces for its own body would be adequate for a human's. We know the level is close, but we don't know if it's close enough.

Nonetheless, Platt's rationale for pursuing this line of research is inarguable: critically ill patients have no alternative. Some 20 to 30 percent die while awaiting a human organ, according to Duke transplant surgeon William Meyers.

Because it is unclear whether a pig liver can function as well as a human liver over an extended period, the livers will not be transplanted into the patient but will be maintained *ex vivo*. Blood will be pumped from a catheter in the patient's leg through an oxygenation device and then into the pig liver, which will be located above the patient's head. The blood will flow back through a catheter in the patient's chest.

Platt has already used nontransgenic livers to maintain several patients this way. One patient spent five days hooked up to a succession of five pig livers. (Each one is good only for only about four to six hours before the host's complement system destroys it.) He subsequently received a human organ, finished college, and now works full time driving a tractor. Because they

express two human complement-inhibiting shield proteins, DAF and CD59, Nextran's transgenic livers are expected to be more effective and last longer.

Meanwhile, Imutran researcher David White is hoping to be next out of the gate with a transgenic organ ready for use in humans. White has successfully transplanted transgenic pig hearts into monkeys with an average survival time of 40 days. Although the hearts remained undamaged, British animal-rights guidelines required that the monkeys be sacrificed because they were suffering terrible distress from the toxic effects of immunosuppressive drugs.

Despite the possibility of similar effects in humans, White is aggressively pressing the British Department of Health for permission to proceed with human trials of his cardiac grafts. He plans to modify the immunosuppression regime and defends his decision to press on by pointing out that, unlike animals, humans can choose how much distress they are willing to tolerate in exchange for the chance to live.

White's persistence has raised some eyebrows among his colleagues in the field of xenotransplantation. "Though I consider myself an aggressive person when it comes to implementing new therapies," says Bach, who pioneered human bone-marrow transplants, "I would not proceed with the porcine cardiac graft at this time."

Nonetheless, Paul Herrling, head of corporate research at Sandoz, Imutran's source of financial support, expects human trials of the pig heart graft to begin within the next couple of years. Human trials of transgenic porcine kidney grafts may also be sought by Imutran in the near future.

Even if transgenic livers, hearts, and kidneys resist rejection, a number of key questions remain to be answered before pig-to-human organ transplantation becomes routine: Will the organs respond appropriately to human hormones and growth factors? Will proteins or carbohydrates secreted by the organ elicit a destructive immune response? Will the pig organ survive the disease process that destroyed the original human organ?

Imutran's monkey experiments indicate that the organs will probably survive and function at least long enough to serve as an interim expedient

while a human organ is sought. However, they also highlight the limitations of pig-to-human transplants as a long-term solution. Immunosuppressive drugs are toxic at high doses and can interfere with critical liver and kidney functions. Some 10 percent of cardiac transplant patients who receive human hearts develop kidney failure as a result of drug treatment. It is unlikely that the severe immunosuppression regimen used for Imutran's monkeys would even be approved for human patients.

For pig organs to become a long-term solution, at least one of several things must happen. The organs will have to be made still more tolerable to humans by further engineering, patients will have to be made more tolerant of pig tissue, or scientists will have to develop immunosuppressive drugs that are more focused and less toxic in their effects. No one can confidently predict whether any or all of these advances will occur. But as IOM committee chair Levinsky points out, only five or ten years ago most observers dismissed the prospects for any future progress in xenotransplantation, and some of the field's proponents were practically ostracized for their views. The unexpected pace of innovation over such a short period of time raises hope that the obstacles to clinical viability can eventually, and perhaps rapidly, be overcome. ■

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The Twilight

IN college, I passed through a phase during which literary criticism struck me as the most thrilling of all possible careers. Critics such as the late Northrop Frye, whose writings bristled with ideas about art, religion, philosophy, and history, seemed to epitomize intellectual achievement. Eventually, though, I had a crisis of faith. One of the messages of modern criticism is that all texts are “ironic”; they have multiple meanings, none of them definitive. Arguments over the meaning of *Hamlet* or *Ulysses* can never be resolved. But critics still keep arguing! To what end? For each critic to be more clever, more interesting, than his or her fellow critics? It all began to seem pointless. * The more frustrated I became with the ironic outlook of literary criticism, the more I began to appreciate the crisp, no-nonsense approach of science. Scientific propositions are tested experimentally and compared to reality, and those found wanting are rejected. The power of science to transform the world cannot be denied. It has given us computers and jets, vaccines and thermonuclear bombs, technologies that, for better or worse, have altered the course of history. Science, more than any other



of Science

BY JOHN HORGAN



*With earth-shat-
tering concepts
such as evolution,
relativity, and
quantum
mechanics
behind us, the
Age of Scientific
Discovery may give
way to the Age of
Diminishing Returns.*

mode of knowledge—literary criticism, philosophy, art, theology—yields durable insights into the nature of things. It gets us somewhere. I concluded that pure science, the pursuit of knowledge as an end in itself, must surely be the noblest and most meaningful of human endeavors. We are here to figure out why we are here. What other purpose is worthy of us?

My mini-epiphany propelled me toward science journalism. It also left me with this inspirational, though wholly unexamined, assumption about science: the quest is open-ended, even infinite. In the late 1980s, however, developments in physics brought that belief into question. Various theorists, notably Stephen Hawking of the University of Cambridge, declared that physics was on the verge of a unified theory, a succinct description of all the basic forces of nature and a possible key to understanding the origin of the universe. Elaborating on this theme in his 1988 blockbuster, *A Brief History of Time*, Hawking speculated that a unified theory would help us to “know the mind of God”—an intriguing statement, coming as it did from an avowed atheist.

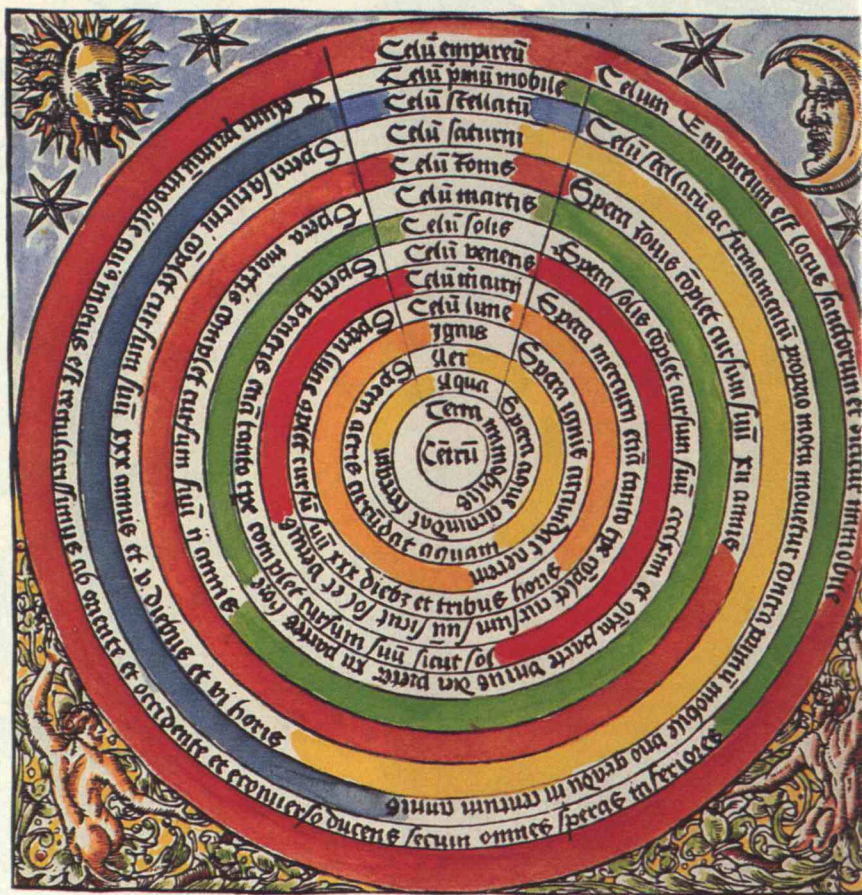
Hawking’s proclamation raised some fascinating—and, to my mind, disturbing—questions. A final theory, Hawking seemed to be suggesting, would solve the riddle of the universe once and for all time. It would transform the “Huh?” of primordial wonder—which underlies all modes of truth seeking—into an “Aha!” of understanding. Was that possible? Could scientists banish mystery from the universe? Could they learn everything there is to know and thus bring science to an end? If so, what would humanity do for the rest of eternity?

For the better part of a decade I have been putting questions like these to scientists who are butting their heads against the limits of knowledge, from particle physicists who dream of a final theory of matter and energy to neuroscientists probing the processes in the brain that give rise to consciousness. I have also read everything I could find on the limits of science—a surprisingly small literature, given the vast importance of the topic. I have gradually become convinced that science is indeed approaching some sort of culmination.

These are trying times for truth seekers. The scientific enterprise is threatened by technophobes, animal-rights activists, religious fundamentalists and, most powerful of all, stingy politicians. Social, political, and economic constraints will make it more difficult to practice science, and pure science in particular, in the future. Moreover, science

itself, as it advances, keeps imposing limits on its own power. Einstein’s theory of special relativity prohibits the transmission of matter or even information at speeds faster than light. Quantum mechanics dictates that our knowledge of the subatomic world will always be slightly blurred. Chaos theory confirms that even without quantum indeterminacy many phenomena would be impossible to predict. Kurt Gödel’s incompleteness theorem denies us the possibility of constructing a complete, consistent mathematical description of reality. And evolutionary biology keeps reminding us that we are animals, designed by natural selection not for discovering deep truths of nature but for breeding.

With the sky no longer the limit for modern science, it



is no wonder that many researchers I interviewed seemed gripped by a nagging unease. But their malaise, I suspect, has another, more profound cause. If one believes in science, one must accept the possibility that the great era of scientific discovery is already over. By science I mean not applied science but science at its purest and grandest, the primordial human quest to understand the universe and our place in it.

By far the greatest barrier to future progress in pure science is its past success. If science is as subjective as art, as some philosophers have suggested, then of course it can go on forever. But scientists have answered some ques-

JOHN HORGAN is a senior writer at Scientific American who has won major awards for his work. This article is adapted from his book *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age*, published in June by Helix Books, a division of Addison-Wesley.

tions beyond a reasonable doubt, and have stitched these findings into a compelling, if not terribly detailed, map and history of existence. All matter consists of a few basic particles, primarily quarks and electrons, governed by a few fundamental forces, namely gravity, electromagnetism, and the strong and weak nuclear forces. The entire universe is expanding, and was once—perhaps 15 billion years ago—much smaller, hotter, and denser than it is now. The earth, which gelled from the detritus of an exploded star some 4.5 billion years ago, revolves around a star within the Milky Way, which is itself just one of countless galaxies populating the cosmos. We humans and all other life on earth evolved by natural selection from single-celled organisms—pond scum, essentially—

science has given us its Darwin, its Einstein, its Watson and Crick, the prospect arises that further research will yield no more great revelations or revolutions but only incremental, diminishing returns.

The Anxiety of Scientific Influence

The long shadows cast by yesterday's giants have put modern scientists in a compromising position. In trying to understand this predicament, I have found that ideas from literary criticism can serve some purpose after all. The critic Harold Bloom of Yale University has argued that all modern poets are latecomers, engaged in an ultimately futile struggle to transcend the perfection of Homer, Shakespeare, and other masters. Modern scientists, too, are latecomers, and their burden is much heavier than that of poets. They must confront achievements that are not merely beautiful but true, empirically true, in a way that no work of art can be. Most researchers concede their inability to overcome what Bloom called "the embarrassments of a tradition grown too wealthy to need anything more"; they settle for refining and applying the brilliant, pioneering discoveries of their predecessors.

Bloom's "strong poet" accepts the perfection of his or her forebears and yet still strives to transcend it. There are strong scientists, too, those who are seeking to transcend quantum mechanics or the Big Bang theory or Darwinian evolution. For the most part they have only one option: to pursue science in a speculative, post-empirical mode that I call ironic science. Ironic science resembles literary criticism in that it offers points of view, opinions—which are at best "interesting" and provoke further comment. But it does not converge on the truth. It cannot achieve empirically verifiable "surprises" that force scientists to make substantial revisions in their basic description of reality.

What constitutes a surprise? Einstein's discovery that time and space, the I-beams of reality, are made of rubber was a surprise. So was the observation by astronomers that the universe is expanding and evolving. Quantum mechanics, which unveiled a probabilistic element at the bottom of things, was an enormous surprise; God does play dice, Einstein's disapproval notwithstanding. The later finding that protons and neutrons are made of smaller particles called quarks was a much lesser surprise, because it merely

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of existence.*

that appeared on the planet roughly 4 billion years ago.

In its broad outlines, this scientific account of reality seems unlikely to change. It has been painstakingly woven together from empirical evidence, and stoutly reinforced by continued observation. It is therefore, as much as any thought that has ever crossed the human mind, true. Sheldon Glashow, a Nobel physicist at Harvard University, remarked in 1989 that the last decade of research in his field had revealed "not the slightest flaw, not the tiniest discrepancy" in the standard model of particle physics. "We have no experimental hint or clue that could guide us to build a more ambitious theory," he lamented. Now that

extended quantum theory to a deeper domain; the foundations of physics remained intact. Learning that we humans were created not instantaneously by God but gradually, by the process of natural selection, was a big surprise. But the testability that gave these discoveries their potency is missing from ironic science.

Superstring theory, which for more than a decade has been the leading contender for a unified theory of physics, is a striking specimen of ironic science. Often called a "theory of everything," it posits that all the matter and energy in the universe, and even space and time, stem from infinitesimal stringlike particles wriggling in a hyperspace consisting of 10 or more dimensions. Unfortunately, the tiny domain that superstrings allegedly inhabit is even less accessible to human experimenters than the quasars haunting the edge of the visible universe; a superstring is as small in comparison to a proton as a proton is in comparison to the solar system. Attaining the energy levels needed to probe this realm directly would require a particle accelerator 1,000 light-years in circumference.

I once raised the issue of testability with the leading proponent of superstring theory, Edward Witten of the Institute of Advanced Study in Princeton. Some consider Witten to possess the greatest mathematical mind since Newton; citations of his work by colleagues over the past 15 years have made him by far the most influential physicist in the world. When I questioned Witten about the lack of empirical evidence for superstrings, he grew exasperated. "I don't think I've succeeded in conveying to you its wonder, its incredible consistency, remarkable elegance, and beauty." Witten seemed to be talking about not a theory of physics but a poem or a sonata, and in a sense he was.

Despite their slipperiness, such theories are often mistaken for genuine advancement of knowledge. This is because the practitioner of ironic science enjoys one obvious advantage over the strong poet: the appetite of the reading public for scientific "revolutions." As empirical science ossifies, journalists like me, who feed society's hunger, will come under more pressure to tout theories that supposedly transcend the received wisdom. Journalists are, after all, largely responsible for the popular notion that ideas such as punctuated equilibrium or Gaia represent genuine challenges to Darwin's theory of evolution, and that chaos and complexity represent genuinely "new" sciences superior to the stodgy reductionism of Newton and Einstein.

Journalists, myself included, have also created the impression that superstring theory—and the equally untestable multi-universe theories now fashionable in cosmology—represent legitimate extensions of science. But as Harvard's Glashow and a colleague, Paul Ginsparg, argued in a 1986 essay, such theories are actually more akin to faith. "Contemplation of superstrings," they wrote, "may evolve into an activity as remote from conventional particle physics as particle physics is from chemistry, to be conducted at schools of divinity by future equivalents of medieval theologians."

Gunther Stent's Golden Age

Science's current impasse was foretold almost three decades ago in a remarkable book, now long out of print, called *The Coming of the Golden Age: A View of the End of Progress*. Its author was Gunther Stent, a biologist at the University of California at Berkeley, who is by far the most astute analyst of the limits of science I have encountered (and by astute I mean, of course, that he articulates my own inchoate premonitions). Stent acknowledged at the outset of his book the apparent absurdity of his claim that science was approaching a cul-de-sac. How can science possibly be nearing an end when it has been advancing so rapidly throughout this century? Stent turned this argument on its head. Initially, he granted, science advances exponentially through a positive feedback effect: knowledge begets more knowledge, and power begets more power. Stent credited the American historian Henry Adams with having foreseen this aspect of science at the turn of the century.

Adams's "law of acceleration," Stent pointed out, has an interesting corollary. If there are any limits to science, any barriers to further progress, then science may well be moving at unprecedented speed just before it crashes into them. When science seems most muscular, triumphant, potent, that may be when it is nearest death. "Indeed, the dizzy rate at which progress is now proceeding," Stent wrote in *Golden Age*, "makes it seem very likely that progress must come to a stop soon, perhaps in our lifetime, perhaps in a generation or two."

Certain fields of science, Stent argued, are limited simply by the boundedness of their subject matter. No one would consider human anatomy or geography, for example, to be infinite endeavors. Chemistry, too, is bounded. "Though the total number of possible chemical reactions is very great and the variety of reactions they can undergo vast, the goal of chemistry of understanding the principles governing the behavior of such molecules is, like the goal of geography, clearly limited." In fact, many chemists think that goal was achieved in the 1930s when Linus Pauling showed how all chemical interactions could be understood in terms of quantum mechanics.

In his own field, Stent asserted, the discovery of DNA's twin-corkscrew structure in 1953, and the subsequent deciphering of the genetic code that passes information from one generation to the next, left only three major questions for biologists to explore: how life began, how a single fertilized cell develops into a multicellular organism, and how the central nervous system processes information. When those goals are achieved, Stent said, the basic task of biology, pure biology, will be completed.

Unlike biology, Stent said, the physical sciences seem to be open-ended. Physicists can always attempt to probe more deeply into matter by smashing particles against each other with greater force, and astronomers can always strive to see farther into the universe. But in their efforts to gather data from ever-more-remote regimes, Stent contended, physicists will inevitably confront various physi-



Certain fields are limited simply by the boundedness of their subject matter. No one would consider human anatomy or geography to be infinite endeavors.

cal, economic, and even cognitive limits.

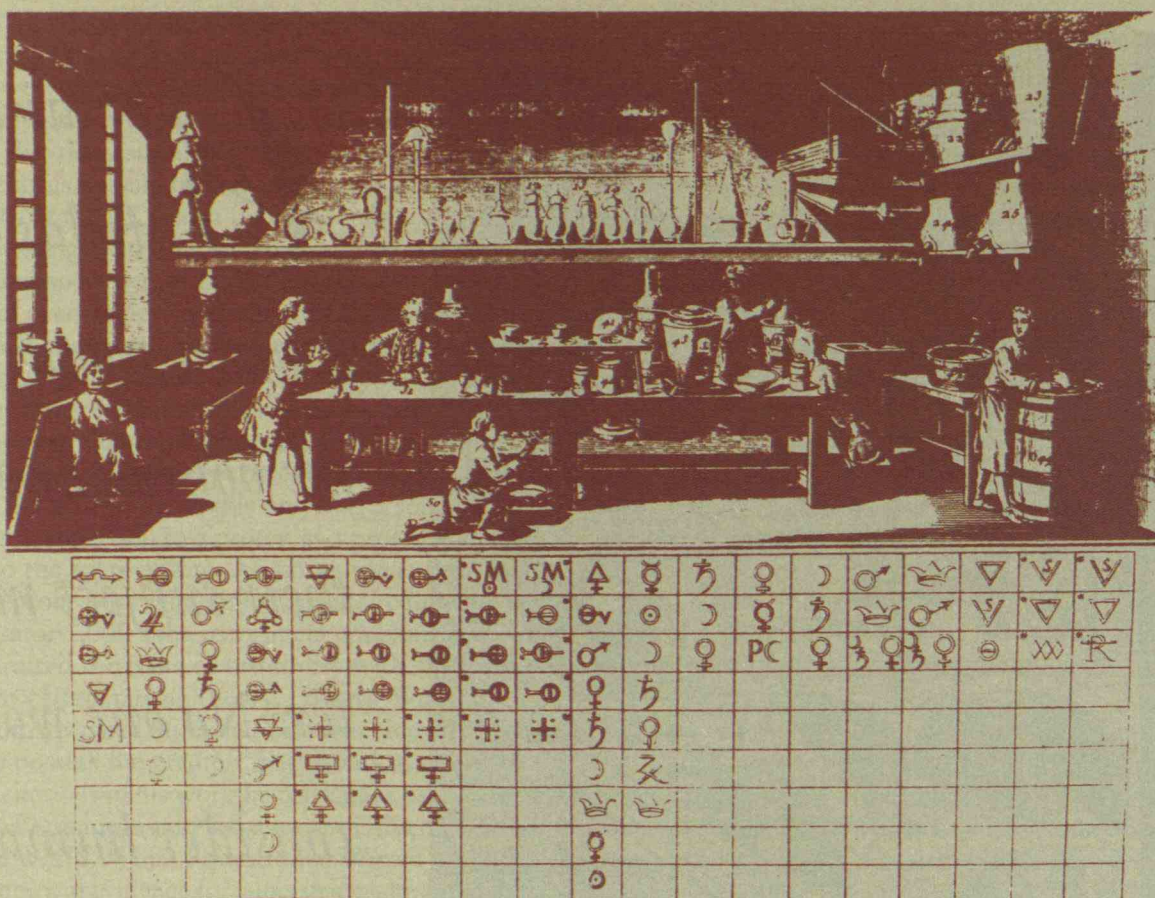
Indeed, over the course of this century, physics has become more and more difficult for anyone, including physicists, to comprehend. Stent rejected the old argument that “yesterday’s nonsense is today’s common sense.” Society may be willing to support continued research in physics as long as it has the potential to generate powerful new technologies. But when physics becomes impractical as well as incomprehensible, Stent predicted, society will surely withdraw its support.

Stent’s prognosis for civilization was an odd mixture of optimism and pessimism. He predicted that science, before it ends, might help to solve many of civilization’s most pressing problems. It would eliminate disease and poverty and provide society with cheap, pollution-free energy, perhaps through the harnessing of fusion reactions. As we gain more dominion over nature, however, we may lose

what Nietzsche called our “will to power”; we may become less motivated to pursue further research—especially if such research has little chance of yielding tangible benefits.

As society becomes more affluent and comfortable, fewer young people may choose the increasingly difficult path of science. Many may turn to more hedonistic pursuits, perhaps even abandoning the “real world” for fantasies induced by drugs or electronic devices feeding directly into the brain. (Virtual reality comes to mind.) Sooner or later, Stent concluded, progress would “stop dead in its tracks,” leaving the world in a largely static condition that he called “the new Polynesia.”

When I interviewed Stent at Berkeley almost 25 years after the publication of *Golden Age*, he was more convinced than ever that science had entered the homestretch. Particle physicists were having difficulty convincing society



to pay for their increasingly expensive apparatus, such as the Superconducting Supercollider. As for biologists, they still had much to learn about how, say, a fertilized cell is transformed into a complex organism such as an elephant, and about the workings of the brain, which he considered the last great frontier in science (Stent turned from molecular biology to neuroscience in the 1970s). But he was convinced that a purely physiological explanation of consciousness would not be as comprehensible or as meaningful as most people would like. In *Golden Age* he had asserted that the “processes responsible for [consciousness] will be seen to degenerate into seemingly quite ordinary, workaday reactions, no more or less fascinating than those that occur in, say, the liver.”

Stent was similarly skeptical toward the claims of investigators of chaos and complexity that computers and sophisticated mathematics will enable them to transcend the science of the past. In *Golden Age*, Stent had discussed the work of one of the pioneers of chaos theory, Benoit Mandelbrot, who had shown that many phenomena are intrinsically “indeterministic”—unpredictable and apparently random. Stent had concluded in *Golden Age* that these indeterministic phenomena would resist scientific analysis, and a quarter-century later he saw no reason to change that assessment. Quite the contrary. The work emerging from chaos and complexity theories demonstrated his point that science, when pushed too far, culminates in incoherence. It must have been apparent to Stent that proponents of these fields had created some potent

metaphors—the butterfly effect, fractals, artificial life—and had attempted to apply them to phenomena such as social organization and the balance of geopolitical power, but had not told us anything about the world that was both concrete and truly surprising. So Stent did not think that chaos and complexity would bring about the rebirth of science? “No,” he said with a rakish grin. “It’s the end of science.”

The “Star Trek” Factor

If my experience is any guide, even people with only a casual interest in science will find it hard to entertain the possibility that science’s days are numbered. It is easy to understand why. We are drenched in progress, real and artificial. Every year we have smaller, faster computers, sleeker cars, more channels on our televisions. Our views of the future are also distorted by what could be called the “Star Trek” factor. How can science be drawing to a close when we haven’t yet invented spaceships that travel at warp speed? Or when we haven’t acquired the fantastic psychic powers—enhanced by both genetic engineering and electronic prosthetics—described in cyberpunk fiction?

Science itself helps to propagate these fantasies. One can find discussions of time travel, teleportation, and parallel universes in reputable, peer-reviewed physics journals. And at least one Nobel laureate in physics, Brian Josephson, has declared that physics will never be complete until it can account for extrasensory perception and telekinesis.

Applied science in this century has tended to reinforce rather than to chal- lenge the prevailing theoretical paradigms.

But Josephson long ago abandoned real physics for mysticism and the occult. If you truly believe in modern physics, you are unlikely to give much credence to ESP or to spaceships that can travel faster than light.

To be sure, applied science will continue for a long time to come. Scientists can keep developing versatile new materials; faster and more sophisticated computers; genetic-engineering techniques that make us healthier, stronger, longer-lived; perhaps even fusion reactors that can provide cheap energy with few environmental side effects (some dreams die hard). The question is, will these advances in applied science bring about any surprises, any revolutionary shifts in our basic knowledge? Will they force scientists to revise the map they have drawn of the universe or the narrative they have constructed of its creation and history? Not if recent history is any indication. Applied science in this century has tended to reinforce rather than to challenge the prevailing theoretical paradigms. Lasers and transistors confirm the power of quantum mechanics, just as genetic engineering bolsters the validity of the DNA-based model of evolution.

Of course, profound discoveries cannot be ruled out. The confirmation that life exists beyond our little planet would constitute a truly revolutionary event. Even if the finding consists merely of fossil bacteria on Mars rather than superintelligent humanoids piloting spaceships, science, and all human thought, might well be reborn. Speculation about the uniqueness of life—or its inevitability—would be placed on a much more empirical basis, because

scientists would finally have more than one data point, terrestrial life, to consider.

But how likely is it that we will discover life elsewhere? In retrospect, the space programs of both the United States and the former Soviet Union represented elaborate displays of saber rattling rather than the opening of a new frontier for human knowledge. The prospects for space exploration on anything more than a trivial level seem less and less likely. We no longer have the will or the money to indulge in technological muscle flexing for its own sake. Humans, made of flesh and blood, may someday travel to other planets here in our solar system. But chances are we will never even attempt to visit another star, let alone another galaxy. A spaceship that can travel 1 million miles per hour—a velocity at least an order of magnitude greater than propulsion systems can now achieve—would still take almost 3,000 years to reach Alpha Centauri, our nearest stellar neighbor. So the prospect of seeking out new life forms in a spiffy dilithium-powered starship is an idea that should boldly go away.

That's What They Thought 100 Years Ago

By far the most common response to the proposition that science might be ending is the “that’s-what-they-thought-at-the-end-of-the-last-century” argument. The argument goes like this: As the nineteenth century wound down, physicists thought they knew everything. But no sooner had the twentieth century begun than Einstein and other physicists discovered relativity theory and quantum mechanics. These theories eclipsed Newtonian mechanics and opened up vast new vistas for modern physics and other branches of science. Moral: Anyone who predicts that science is nearing its end will surely turn out to be as shortsighted as those nineteenth-century physicists.

People who believe science is finite have a standard retort for this argument: the earliest explorers, because they could not find the edge of the earth, might well have concluded that it was infinite, but they would have been wrong. Moreover, it is by no means a matter of historical record that late-nineteenth-century physicists felt they had wrapped things up. The best evidence for a sense of completion is a speech given in 1894 by Albert Michelson, whose experiments on the velocity of light helped to inspire Einstein’s theory of special relativity. Michelson stated:

“While it is never safe to say that the future of Physical Science has no marvels even more astonishing than those of the past, it seems probable that most of the grand underlying principles have been firmly established and that further advances are to be sought chiefly in the rigorous application of these principles to all the phenomena which come under our notice. It is here that the science of measurement shows its importance—where quantitative results are more to be desired than qualitative work. An eminent physicist has remarked that the future truths of Physical Science are to be looked for in the sixth place of decimals.”

Michelson’s remark about “the sixth place of decimals”

has been so widely attributed to Lord Kelvin (after whom the Kelvin, a unit of temperature, is named) that some authors simply credit him with the quote. But historians have found no evidence that Kelvin made such a statement. Perhaps more important, at the time of Michelson's remarks physicists were vigorously debating fundamental issues, such as the viability of the atomic theory of matter, according to Stephen Brush, a historian of science at the University of Maryland. Michelson was so absorbed in his optics experiments, Brush suggests, that he was "oblivious to the violent controversies raging among theorists at the time." The alleged "Victorian calm in physics," Brush concludes, is a myth.

Another anecdote favored by those reluctant to accept the mortality of science is that in the mid-1800s, the head of the U.S. Patent Office quit his job and recommended that the office be shut down because there would soon be nothing left to invent. In 1995, Daniel Koshland, editor of the prestigious journal *Science*, repeated this story in an introduction to a special section on science's future. In the section, leading scientists offered predictions about what their fields might accomplish over the next 20 years. Koshland, who like Gunther Stent is a biologist at the University of California at Berkeley, exulted that his prognosticators "clearly do not agree with that commissioner of patents of yesteryear. Great discoveries . . . are in the offing."

There were two problems with Koshland's essay. First, the contributors to his special section envisioned not "great discoveries" but, for the most part, rather mundane applications of current knowledge, such as better methods for designing drugs, improved tests for genetic disorders, more discerning brain scans, and the like. Some predictions were downright negative. "Anyone who expects any human-like intelligence from a computer in the next 50 years is doomed to disappointment," proclaimed the Nobel physicist Philip Anderson.

The second problem with Koshland's essay was that his story about the commissioner of patents is apocryphal. In 1940, a scholar named Eber Jeffery examined the patent-commissioner tale in an article titled "Nothing Left to Invent," published in the *Journal of the Patent Office Society*. Jeffery traced the story to congressional testimony delivered in 1843 by Henry Ellsworth, the commissioner of patents. Ellsworth remarked at one point: "The advancement of the arts, from year to year, taxes our credulity and seems to presage the arrival of that period when human improvement must end."

But Ellsworth, far from recommending that his office be shut down, asked for extra funds to cope with the flood of inventions he expected in agriculture, transportation, and communications. Ellsworth did indeed step down two years later, in 1845, but in his resignation letter he made no reference to closing the Patent Office; he only expressed pride at having expanded it. Jeffery concluded that Ellsworth's statement about "that period when human improvement must end" represented "a mere rhetorical flourish intended to emphasize the remarkable strides for-

ward in inventions then current and to be expected in the future." But perhaps Jeffery was not giving Ellsworth enough credit. Ellsworth was, after all, anticipating the argument Gunther Stent would make more than a century later: the faster science moves, the faster it will reach its ultimate, inevitable limits.

The Rise and Fall of Progress

Consider the implications of the alternative position, that because science has advanced so rapidly over the past century or so, it can and will continue to do so, possibly forever. This inductive argument is deeply flawed. Science has existed for only a few hundred years, and its most spectacular achievements have occurred within the last century. Viewed from a historical perspective, the modern era of rapid scientific and technological progress appears to be not a permanent feature of reality but an aberration, a fluke, a product of a singular convergence of social, intellectual, and political factors.

In his 1932 book *The Idea of Progress*, the historian J.B. Bury stated: "Science has been advancing without interruption during the last three or four hundred years; every new discovery has led to new problems and new methods of solution, and opened up new fields for exploration. Hitherto men of science have not been compelled to halt, they have always found means to advance further. But *what assurance have we that they will not come up against impassable barriers?*" [Italics in the original.]

Bury himself had demonstrated through his scholarship that the concept of progress is relatively young. From the era of the Roman Empire through the Middle Ages, most truth seekers held a degenerative view of history: the ancient Greeks had achieved the acme of mathematical and scientific knowledge, and civilization had gone downhill from there. It was such founders of modern, empirical science as Isaac Newton, Francis Bacon, René Descartes, and Gottfried Leibniz who first set forth the idea that humans could systematically acquire and accumulate knowledge through investigations of nature. Most of these prime movers believed that the process would be finite, that we could attain complete knowledge of the world and then construct a perfect society, a utopia, based on that knowledge (the new Polynesia!).

Only with the advent of Darwin did certain prominent intellectuals become so enamored with progress that they insisted it might be, or should be, eternal. "This optimistic view came to be so widely embraced in the industrialized nations," wrote Stent in a 1978 book, *The Paradoxes of Progress*, "that the claim that progress could presently come to an end is now widely regarded [to be] as outlandish a notion as was in earlier times the claim that the Earth moves around the sun."

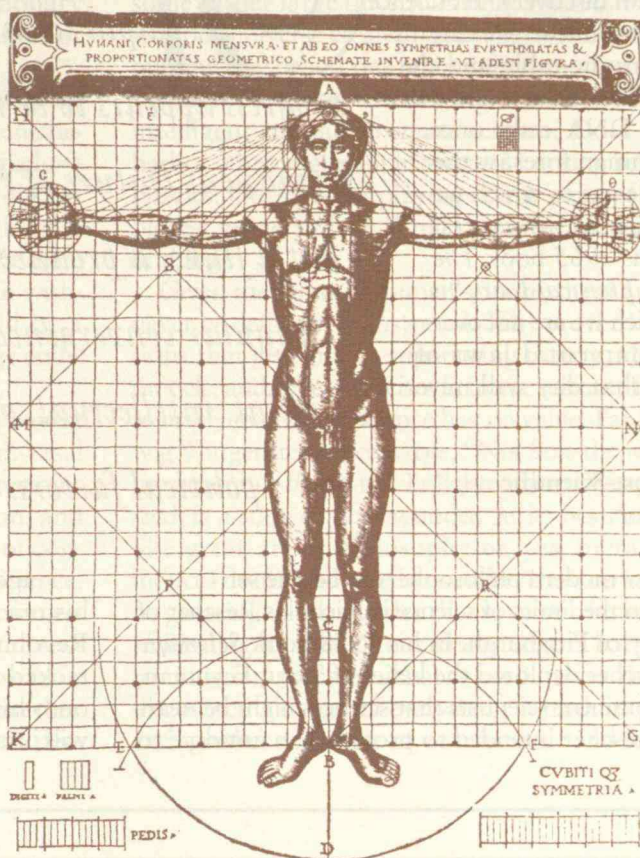
In 1945 the physicist Vannevar Bush proclaimed in *Science: The Endless Frontier*—the essay that served as a blueprint for the National Science Foundation and other federal organizations that thereafter supported basic research on an unparalleled scale—that science was "a

largely unexplored hinterland” and an “essential key” to U.S. military and economic security. But powerful social, political, and economic forces now oppose this bountiful vision of scientific and technological progress. Society has become more sensitive to the adverse consequences of science and technology, such as pollution, nuclear contamination, and weapons of mass destruction.

Even political leaders, many of whom have been the staunchest defenders of the value of scientific progress, have begun voicing anti-science sentiments. The Czech poet and president Václav Havel declared in 1992 that the Soviet Union epitomized and therefore eternally discredited the “cult of objectivity” brought about by science. Havel expressed the hope that the dissolution of the communist state would bring about “the end of the modern era,” which he said had been “dominated by the culminating belief, expressed in different forms, that the world—and Being as such—is a wholly knowable system governed by a finite number of universal laws that man can grasp and rationally direct for his own benefit.”

This disillusionment with science was foreseen early in this century by Oswald Spengler, the German schoolteacher who became the first great prophet of the end of science. In his massive tome *The Decline of the West*, published in 1918, Spengler argued that science proceeds in a cyclic fashion, with “romantic” periods of investigation of nature and the invention of new theories giving way to periods of consolidation in which scientific knowledge ossifies. As scientists become more arrogant and less tolerant of other belief systems, notably religious ones, Spengler declared, society will rebel against science and embrace religious fundamentalism and other irrational systems of belief. Spengler predicted that the decline of science and the resurgence of irrationality would begin at the end of this millennium.

Spengler’s analysis was, if anything, too optimistic. His view of sci-



*As long as civilization
is ravaged by poverty,
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ignorance, it is hard to imag-
ine that society will not con-
tinue striving to improve its
lot through applied science.*

ence as cyclic implied that science may one day be resurrected and undergo a new period of discovery. Yet science is not cyclic but linear; we can discover the periodic table and the expansion of the universe and the structure of DNA only once. Richard Feynman foresaw this impasse. "The age in which we live," the great physicist declared in his 1965 book *The Character of Physical Law*, "is the age in which we are discovering the fundamental laws of nature, and that day will never come again."

What Will Post-Scientific Humanity Do?

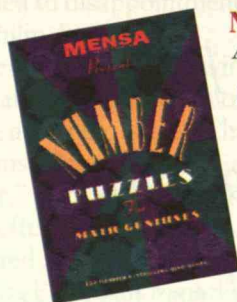
One of the few modern philosophers to devote serious thought to the limits of science is Nicholas Rescher of the University of Pittsburgh. In his 1978 book *Scientific Progress*, Rescher deplored the belief of Stent, Feynman, and other prominent scientists that science might be nearing an end. Rescher intended to provide "an antidote to

*R*apid scientific progress appears to be not a permanent feature of reality but a fluke, a product of a singular convergence of social, intellectual, and political factors.

this currently pervasive tendency of thought" by demonstrating that science was at least potentially infinite. But the scenario he sketched out over the course of his book was hardly optimistic. He argued that science, as a fundamentally empirical, experimental discipline, faces economic constraints. As scientists try to extend their theories into more remote domains—seeing farther into the universe, deeper into matter—their costs will inevitably escalate and their returns diminish.

"If the present perspective is even partly correct," Rescher wrote, "the half-millennium commencing around 1650 will eventually come to be regarded among the great characteristic developmental transformations of human history, with the age of The Science Explosion as unique in its own historical structure as The Bronze Age or The Industrial Revolution or The Population Explosion." Rescher tacked what he apparently thought was a happy coda onto his depressing scenario: science will never end—it will just go slower and slower and slower, like Zeno's tor-

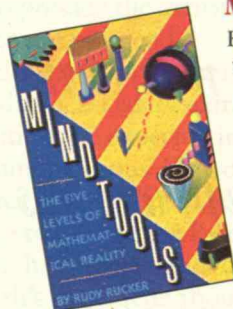
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toise. Not that scientists' work must degenerate into the mere filling in of details; it is always possible that one of their ever costlier experiments will have revolutionary import, comparable to that of quantum mechanics or Darwinian theory.

When I telephoned Rescher, he acknowledged that his analysis had been in most respects a grim one. He nonetheless insisted that "big plums, first-rate discoveries," might—must!—lie ahead. He could not say where such a discovery might come from. "It's like the jazz musician who was asked where jazz is going, and said, 'If I knew we'd be there by now.'" Rescher admitted that he was engaging in wishful thinking. The end of science, he said, would be a "tragedy" for humanity. If the quest for knowledge ends, what will give our existence meaning?

Paradoxically, science's failures may represent its greatest hope. We obviously are nowhere near the era of universal leisure that Stent envisioned. As long as civilization remains ravaged by poverty, disease, famine, war, pollution, and ignorance, it is hard to imagine that society will not continue striving to improve its lot through applied science. Although physicists may never harness fusion for commercial power, they may still find cleaner, cheaper, more sustainable methods for producing energy than those we have now. Biologists are unlikely to make us immortal, but they may still find better treatments or even cures for such dev-

astating illnesses as AIDS, cancer, and schizophrenia.

Moreover, pure science, as far as it has come, has left some rather large questions unanswered. How, exactly, was our universe created, and what will be its fate? Could our universe be just one of an infinite number of universes? Just how inevitable was the origin of life, and of organisms intelligent enough to create science? Does the universe harbor other intelligent life forms? Lurking behind all these puzzles, like an actor playing all the parts of a play, is the biggest mystery of all: Why is there something rather than nothing?

Given the limits of human science, these questions may never be definitively answered. They are the kinds of questions that give rise to superstring theory, multi-universe models, and other exercises in ironic science. I do not mean to imply that ironic science has no value. Far from it. Ludwig Wittgenstein once wrote, "Not *how* the world is, is the mystical, but *that* it is." Enlightenment, Wittgenstein realized, is a state of pure wonder. At its best, ironic science, like great art or philosophy or, yes, literary criticism, induces doubt and awe in us rather than certainty; it keeps us guessing as we ponder the mystery of the universe. By reminding us that all our knowledge is half-knowledge, ironic science ensures that we will never think we have discovered a theory of everything, a truth so potent that it extinguishes our sense of wonder once and for all time. ■

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Navigating the Narrows of Doctor-Assisted Suicide

AFTER years of debate, prompted by high-profile cases such as those involving Jack Kevorkian, our laws may soon widely recognize a right to physician-assisted suicide. Two federal appeals courts, with jurisdictions including New York, California, and nine other states, have recently held that terminally ill patients have a constitutional right to this way of ending life. And in Oregon, a public referendum has resulted in the enactment of a statutory right to assisted suicide for terminally ill residents.

Opponents of assisted suicide—including the American Medical Association—have argued that its legalization poses serious threats to the welfare of patients and the ethics of the medical profession. While most of the concerns do not hold up under scrutiny, some are valid and must be addressed through stringent safeguards.

Many commentators say there is no need for assisted suicide as long as doctors provide adequate pain control. These observers point out that more needs to be done to ensure that dying patients receive enough medication for their pain. Still, some patients' pain cannot be alleviated even with the most aggressive treatment. More important, physical pain is not the only cause of intolerable suffering. Many dying patients want to end their lives because of their utter dependence on others, the wasting of the

*As courts
and legislatures open
the door to the practice,
we need to develop safeguards
to ensure that it develops
responsibly.*

body into little more than flesh and bones, the loss of control over bodily functions, the unrelieved mental and physical exhaustion, and the knowledge that things will only grow worse.

People who oppose doctor-assisted suicide have also pointed out the real risk that the practice may extend to inappropriate cases. Vulnerable patients could ask to end their lives because of pressures from family, caregivers, or insurers, and they may be influenced by arguments about the burden that treatment for dying patients places on society's limited resources. Patients seeking assisted suicide may be suffering from treatable depression or the side effects of medication, and doctors might not always be adequately trained to distinguish requests that are rational from those that are not. Moreover, physicians sometimes find that caring for patients who are seriously ill is time-consuming

and psychologically draining, and may thus respond to entreaties for assisted suicide too readily.

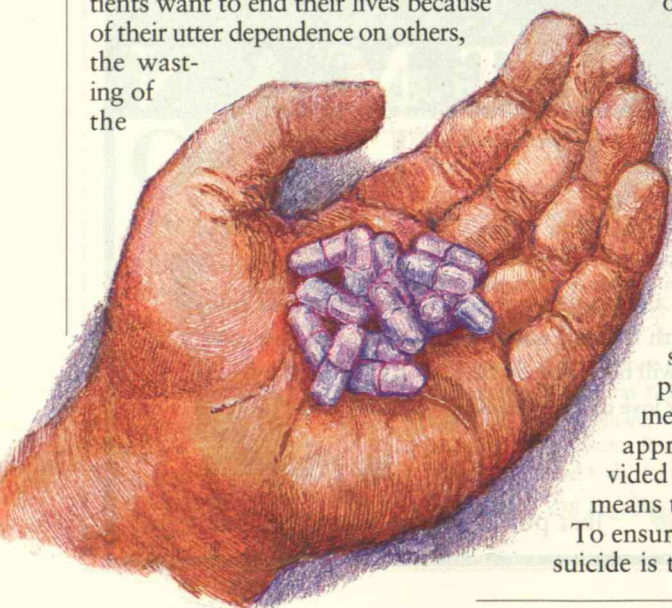
Society should address these possibilities with safeguards rather than a prohibition, just as has been done when requests for withdrawal of life-sustaining treatment have posed similar risks. A specialist in pain relief and other palliative measures should ensure that all appropriate care has been provided to patients asking for the means to hasten the dying process. To ensure that a request for assisted suicide is truly voluntary and not the

result of moral incapacity or undue pressure, a psychiatric specialist should fully evaluate the requesting patient. And a social-services specialist should determine that all other support services have been considered, such as home hospice care, which some patients might prefer over assisted suicide.

Still, critics point out that some doctors might want to disregard such safeguards. Multiple consultations take time and cost money, and physicians may be tempted to shortcut the process. The risks of abuse are real, according to findings from the Netherlands, where doctor-assisted suicide and euthanasia are practiced. In 1991 researchers reported that Dutch physicians had not fulfilled the country's procedural requirements in more than 25 percent of the cases involving these methods of dying. But the United States can avoid a similar experience. Since in Holland the primary abuse has been the administration of euthanasia by doctors without the patient's clear consent, U.S. laws can continue to prohibit euthanasia and insist that the right to assisted suicide be limited to patients who can self-administer the fatal dose of medication. While this requirement would deny death to patients so incapacitated they cannot take drugs by themselves, the right to assisted suicide should not be extended too far.

Moreover, laws should permit doctors to assist in the suicide only of terminally ill patients. Such a limitation would not only restrict the procedure to a justified group but would also tie the practice to the reason society has strongly supported a right to refuse life-sustaining treatment. For example, in its 1976 landmark opinion in the case of Karen Quinlan, the New Jersey Supreme Court observed that treatment withdrawal should be permitted when the patient's prognosis becomes very poor and the degree of bodily invasion from treatment becomes very high. To ensure that a person has reached such a stage, a second, independent physician with expertise in the patient's illness should confirm any diagnosis and prognosis.

To a certain extent, the courts can



REFLECTIONS OF THE DREAM

Twenty Years Celebrating the Life of Dr. Martin Luther King, Jr. at the Massachusetts Institute of Technology 1975-1994

Edited by Clarence G. Williams, Special Assistant to the President, Ombudsperson, and Adjunct Professor of Urban Studies and Planning at MIT



implement safeguards for assisted suicide. But years may be needed for cases to work themselves through all levels of appeals, and court decisions often address only part of an issue at a time. Legislatures can move more quickly, and should address the topic of assisted suicide comprehensively after analyzing the full range of perspectives. State legislatures should handle this issue because experimentation by different states will help sort out the best approaches, a process the courts have long held important.

As legislatures and the courts develop and insist on safeguards, they would do well to recognize that permitting doctor-assisted suicide will actually prolong some patients' lives. What patients often want is not so much the ability to die but the knowledge that they have control over the timing of their death. Once such control is permitted, they may be more willing to undergo aggressive medical treatments that are painful and risky. If a treatment does not succeed but only worsens the patient's condition, the person is assured that he or she can end the suffering.

We have already seen the life-prolonging effects of patient control. Both Elizabeth Bouvia, who depended on a feeding tube, and Lawrence McAfee, who required a ventilator, sued to have their treatment stopped. But neither exercised that right once the courts recognized it. The two were willing to continue their lives upon receiving clear authority that they could decide whether and when their treatment would end.

By adopting stringent safeguards for doctor-assisted suicide, society can give dying patients the fundamental ability to decide how they wish to handle their suffering. And it can provide the critical assurance that they are protected from abuse. ■

DAVID ORENTLICHER, a lawyer and physician, is an associate professor at Indiana University School of Law, Indianapolis, and acting director of the Center for Health Care Ethics and Professionalism at the School of Medicine. He was formerly director of the American Medical Association's Division of Medical Ethics.

Bringing together speeches given at MIT's annual Martin Luther King, Jr. Celebration, this book celebrates two decades of commitment by MIT to honoring the memory and furthering the work of Martin Luther King, Jr. In reading these speeches, one catches in reflection twenty years of turmoil and change, some positive (including an increasing number of speakers drawn from the ranks of MIT's African-American alumni and alumnae) much negative, in which Dr. King's dream has been a continuing beacon for action. Speakers include leaders who are prominent both nationally and in the local (Boston/Cambridge) community in accordance with Dr. King's dual emphasis on global and local issues. The book closes with Coretta Scott King's twentieth anniversary address in 1994. The 1995 speech by A. Leon Higginbotham is included as an appendix.

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Financial institutions have not yet evolved a tradition of such support. Some indicate that they fulfill their responsibility to universities merely by providing good jobs. Such short-sighted thinking avoids financial realities and bypasses an exceptional opportunity to help determine the preparation students receive. The partnership between corporations and universities provides relevance, resources, and reach for both parties. The financial industry and engineering schools are not old friends but should become much better acquainted. We need each other more and more.

THOMAS R. MOEBUS
Director, Corporate Relations
MIT

Wall Street now employs many engineers—not necessarily only those who specialize in computer science. My case is a reasonable example. I hold a PhD in water resources engineering and have worked overseas. Disgruntled by the pay scales within my field, I ventured into banking. As a programmer, I used skills I acquired during my engineering training. I have also been able to apply my technical knowledge to the risk-management side of banking, thereby embracing a field that uses more of my conceptual thinking ability and mathematical background. I have met many individuals on Wall Street whose careers have taken a similar turn.

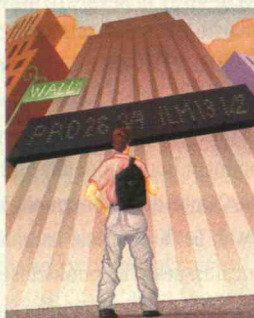
Maybe finance is the industry that will pick up the slack left by many engineering fields and companies. For those who are heading in that direction, my advice is: be alert, expand your skills (including the social ones), and do not take layoffs personally.

KEN AKHOUNDI
J.P. Morgan
New York City

"An Engineer Goes to Wall Street" highlights a trend that goes far beyond the financial industry. The tools and techniques of engineering, mathematics, and science are driving innovation in virtually all businesses—even traditionally low-tech ones.

As Solomon points out, engineers have much to learn to succeed in the business world. But it is also true that managers need to learn from the insights, creative approaches, and problem-solving skills common in technical disciplines—a fact that many of the leading business schools have long embraced in selecting faculty, designing curricula, and conducting research.

The techniques of engineering and mathematics not only generate a wealth of ideas for new products, processes, and services, but also provide new ways to practice management itself. Marketing, for example, has become a complex blend of statistics and computer simulation.



Economic models are playing a greater role in strategic planning and decision making. Telecommunications and information technology offer opportunities to completely rethink company structures and operations.

Business leaders must have vision, insight, energy, and experience. But to make decisions, innovate, and lead in any industry, they must also be fluent in the emerging techniques and technologies that are more than ever the basis of their profession.

Glen L. Urban
Dean
MIT Sloan School of Management

Computer scientists working in finance would do well to consider the fundamental soundness of trading programs and the derivatives they create before unleashing them. Solomon's failure to explain capital markets was a disservice. Market liquidity is a fine thing, but ethical purposes are not served if traders create a market bubble into which small players move and are later stranded. Poorly conceived investments destroy the original intent of capital markets, which is to allow the movement of money into productive—

not just profitable—investments.

Derivatives, for example, are not productive. They are bets on bets that introduce volatility, encourage rogue traders and con artists, and allow institutions to withhold large pools of capital from the productive economy without penalty.

I ask technologists not to respond, "We just build things. Somebody else decides how to use them." If they do not help the public understand the potential risks and rewards of the gadgets they visit on the rest of us, they may help widen the gap between rich and poor and undermine our economic health.

MURRAY JANKUS
Syracuse, N.Y.

The trends described in the article leave me disgusted and scared. As international capitalism impoverishes more and more of the planet, further support of these unjust and inhumane industries by young and talented people is an outrage. In fact, I would take editor Steven J. Marcus's observations (*First Line*, *TR January 1996*) one step further. If some of our brightest hopes for rescuing us from capitalism end up aiding and abetting such waste, we will see misery, starvation, and environmental degradation that much more quickly. I just ask those considering such a future to wake up. Society needs more help than capitalists need more wealth.

AARON GOLUB
Graduate Student
Department of Mechanical Engineering
MIT

COEXISTING WITH VOLCANOES

In "Under the Volcano" (*TR January 1996*), author Peter Tyson highlights a potentially tragic irony of modern volcanology. Although rapid advances in technology and scientific understanding have made it possible to predict some eruptions, the risk from volcanic eruptions is greater than ever before. This is because the rate at which towns and cities are encroaching on volcanoes has outpaced our ability to mitigate their effects. Will science and society win this high-stakes race, or will thousands more
Continued on page 72

I know a young aeronautical engineer who recently made a most unusual career choice. It all began when, unable to find work in his professional specialty, he accepted a position teaching science to students at a private elementary school in New York. Opportunity had knocked when the school's science teacher took a sabbatical leave. The young man had no formal teacher training, but he had helped out in the teacher's classroom during his college vacations, and the administrators at this progressive institution decided to take a chance on using him as a one-year replacement. The experiment worked out wonderfully well, with the children becoming excited about everything from Pluto to polymers, and the young engineer was enthralled. "I discovered that I'm a teacher at heart," he reported at year's end.

Before hearing this story, I had not given much thought to engineers becoming schoolteachers. However, with my intellectual antennae freshly sensitized, I soon got wind of a program in California called the Scientists to Teachers Project. Funded by the Department of Defense as part of its Defense Reinvestment Initiative, and coordinated by the National Research Council, this enterprise proposes to make out-of-work aerospace professionals into high-school math and science teachers. The initiative has selected 14 "teaching fellows" (average age 49) to train at California State University at Long Beach. Embarked on a year-long course featuring in-classroom work with experienced teachers, and supported with a \$22,000 stipend, the fellows will be ready to start work in Los Angeles schools this September. "The schools love our people," says the program director, and the engineers have equally positive feelings.

The idea has taken root elsewhere. MIT's teacher training program, for example, is now in its third year. Of last year's 25 graduates, 19 have continued on the track toward full certification—a process that entails student-teaching in local schools, plus taking at least two education courses at Wellesley College. At the City College of New York this year, 11 engineering students have embarked on a

Teachers at Heart

Might engineers apply their knowledge and passion to educating and inspiring young students? That choice is becoming more common.



SAMUEL C. FLORMAN

course that includes work as teaching assistants at Brooklyn Technical High School. Certification will require one semester of education courses beyond graduation, although there are efforts under way to achieve this within a 4-year curriculum. The University of Washington will launch a similar program this summer. These three schools are members of the Engineering Coalition of Schools for Excellence in Education and Leadership (ECSEL), funded by the National Science Foundation. The coalition's overall aim is to integrate design into the educational experience.

We should not draw too sweeping a conclusion from these activities. Most engineers still intend to make more traditional use of their skills and training. Good teaching requires patience and a sense of "calling" that many engineers lack. Fur-

ther, how many engineers, even if intrigued by the idea of teaching, are willing to make a financial sacrifice? But here the facts belie long-held assumptions. As teachers' compensation has steadily grown, and the purchasing power of salaried engineers has leveled off, the median incomes of the two groups have converged. Considering the job security, attractive working hours, and quality of life that a teaching career offers, "sacrifice" is not the word that comes to mind.

But doesn't a college degree in engineering become overkill for teaching math and science to schoolchildren? Not necessarily. "Learning how to design things is the key to it all," says the young man whose experience first prompted my interest in the subject. "It's the application of math and science to real-world problems that counts. This is what engineers have to offer, and this is what excites the children. This is how they learn. And this is what educators have been missing."

When students design a gadget to collect solar heat, or a winch using assorted gears and shafts, or a bridge made out of dry spaghetti, they learn about energy, temperature, color, weight, mass, force, torque, stress, strain, materials, and molecules—plus mathematics, of course—absorbing this knowledge in the stimulating context of cooperative inquiry. Even when lessons are derived from standard texts, engineers are uniquely qualified to emphasize practical applications, and constructively to cross artificial lines between disciplines. The leaders of the ECSEL programs view their mission as not only helping engineers learn to teach but also encouraging professional teachers to broaden their view of what teaching can be.

Although this "movement" still engages only a few people, perhaps the idea of engineer-teachers is destined to have a profoundly important impact. Engineering is a product-oriented profession. Yet what more important product can there be than the minds and imaginations of the next generation? ■

SAMUEL C. FLORMAN is a civil engineer. His latest book, *The Introspective Engineer*, was published in March by St. Martin's Press.

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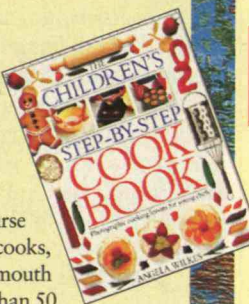


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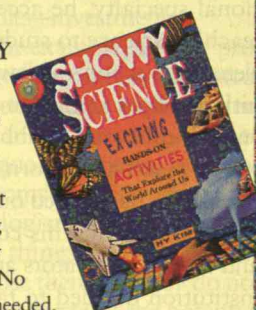
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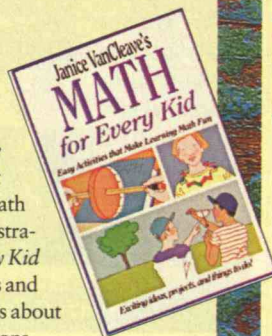


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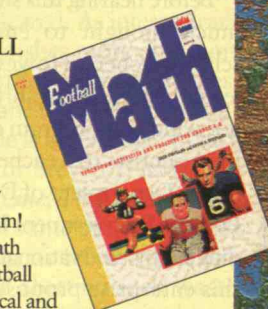
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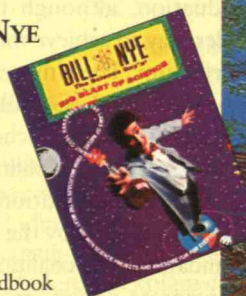


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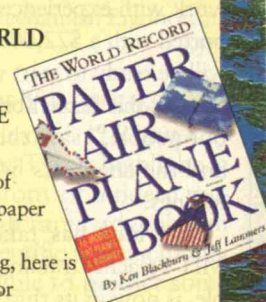
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DOES it still make sense for urban planners and business entrepreneurs to think of the big city as a proper home for manufacturing? Such industry has historically been associated with cities, but many of the more productive and profitable companies have moved elsewhere.

Still, urban manufacturing need not be an anachronism or an oxymoron. Some cities around the world continue to attract new manufacturing, much of it involving production of commodities such as clothing. Although working conditions in the sweatshops of Los Angeles, New York, and London that employ immigrant workers are substandard, sometimes even brutal, such shops nevertheless employ millions of workers.

But commodities are not the whole of urban manufacturing. U.S. cities are also home to high-value-added niche producers of goods such as machine tools, high-end fashion clothing, and designer furniture. Another growing sector that has sprouted in cities includes companies that service office equipment. Such work, while it may not be officially counted as "manufacturing," entails the kind of skilled work long associated with manufacturing. Then there is the production of computer software, which amounts to manufacturing by all conventional economic criteria, even though U.S. government statisticians are reluctant to classify it as such. Software production is revitalizing whole sections of such big cities as Los Angeles and New York.

Many manufacturing establishments are not stand-alone, isolated entities, as conventional economic theory assumes, but rather nodes within extensive boundary-spanning networks. Thus the search by transnational companies and alliances of companies for "windows" into localities with innovative small firms and particular kinds of labor creates striking possibilities for the sustenance and even revival of urban manufacturing.

A vital manufacturing sector is essential to a city's economic health. On average, manufacturers provide greater upstream and downstream connections to other sectors of the economy than do service com-

Made in the City

*Local organizations
are fostering the
revival of urban
manufacturing—one
element in building
a durable prosperity.*



BENNETT HARRISON

panies. These linkages underlie economic growth; technical innovations in capital-goods industries such as machinery and computers diffuse downstream to users of the new equipment and processes, accelerating their competitive advantages.

Recognizing this value, urbanists in cities around the country are working to create attractive environments, including world-class infrastructure, for small- and medium-sized manufacturers. One approach is the business incubator—a building or complex in which several commercial and industrial tenants share common overhead services, making otherwise high-rent urban locations affordable. (One exciting example—the Greenpoint Manufacturing and Design Center—is the subject of the superb film, "Made in Brooklyn," distributed by New Day Films.)

Meanwhile, new kinds of community/labor-union collaboratives are upgrading the technical capabilities of smaller manufacturers, especially in clothing, textiles, and machinery-making. New York City, for example, has the 10-year-old Garment Industry Development Corp.—a collabo-

ration among companies, unions, and federal and municipal governments dedicated to modernizing technology and work rules. In San Francisco, Asian Neighborhood Design—an alliance between community groups, municipal officials, and labor unions—trains disadvantaged workers in design and construction of cabinets, furniture, and even entire buildings. Also in California, business, labor, and government organizations are collaborating through CALSTART—a consortium dedicated to creating in Los Angeles a commercially viable base for the design and manufacture of electric cars. All these ventures focus on improved quality and faster delivery, and are oriented to the export market as well.

No matter how energetic and well-conceived these initiatives, sustaining or rebuilding even a modest manufacturing base within cities is impossible without supportive public policy. Unfortunately, government programs and policies tend to push in the other direction; the subsidy of highways at the expense of public transit, for instance, gives suburbs and exurbs an edge in attracting businesses, while low tariffs encourage companies to move their manufacturing operations offshore. At the local level, mayors, city councilors, and bond traders seem more interested these days in being "fiscally responsible" (meaning paring expenditures on public goods and services) than in financing new (or refurbished) infrastructure, investing in manufacturing modernization, or providing top-notch education and job training to the poor and immigrant populations that must form an important part of the workforce for revitalized urban manufacturing.

The nurturing of manufacturing zones in even the smallest of localities will thus depend on high-stakes policy and politics at all levels of government. But what better time for a national dialog on urban policy than during a presidential election campaign? ■

BENNETT HARRISON has recently joined the New School for Social Research in New York City as professor of urban political economy. He is the author most recently of Lean and Mean: The Changing Landscape of Corporate Power in the Age of Flexibility (Basic Books).

Reviews

BOOKS

CONFRONTING THE NEW NUCLEAR THREAT

*Avoiding Nuclear Anarchy:
Containing the Threat of Loose Russian
Nuclear Weapons and Fissile Material*

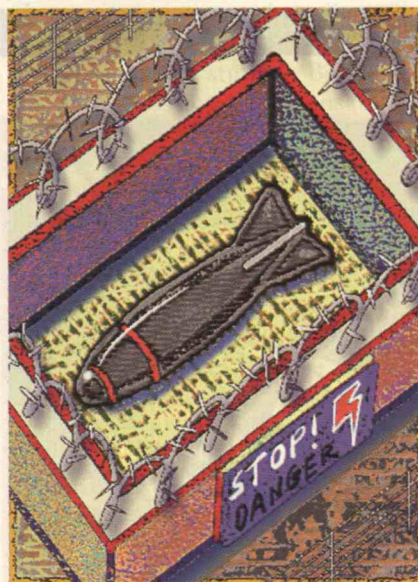
by Graham T. Allison, Owen R. Coté, Jr., Richard
A. Falkenrath, and Steven E. Miller
MIT Press, \$15.00

BY CLARK C. ABT

ACCORDING to *Avoiding Nuclear Anarchy* by Graham T. Allison and his colleagues Owen R. Coté Jr., Richard A. Falkenrath, and Steven E. Miller, the threat posed by Russian fissile material has actually grown since the end of the Cold War. Russia's nuclear complex is still the world's largest, with a million employees in hundreds of facilities. Some 1,200 tons of fissile material, enough for 100,000 nuclear bombs, are stored in those facilities—often insecurely enough to invite smuggling, thanks to warhead dismantlement and the disrupted security arrangements of the former Soviet Union. And in fact, terrorists, crime cartels, and hostile states are creating an international market for such material.

As long as already-existing fissile material can be smuggled, large-scale (and observable) industrial production of it is unnecessary. That undermines the Non-Proliferation Treaty, the Strategic Arms Reduction Treaties (START I & II), and the expected Comprehensive Test Ban, since the availability of nuclear bomb material bypasses most of these constraints on bomb production.

Lest readers delude themselves that fissile material is one thing and finished bombs quite another, the book provides a primer by Owen Coté that shows how easy it is to make those weapons. A bomb's worth of fissile material is as safe



and easy to carry as a soda can, Coté points out, and a simple nuclear weapon can be produced in a machine shop in a matter of months.

Heedless Privatization

To help deal with the situation, *Avoiding Nuclear Anarchy* offers the first comprehensive critique of the nuclear arms reduction and non-proliferation efforts that the United States and Russia have undertaken in the last five years. These include such important initiatives as moving 600 kilograms of insecurely stored uranium from Kazakhstan to the United States; authorizing \$1.2 billion to help dismantle surplus Russian nuclear weapons and facilitate conversion of the defense industry; and establishing an International Science and Technology Center that assists Russian scientists in making the transition to non-military research. All of the measures are worth supporting, Allison and his colleagues say, but insufficient to counter the rapidly growing threat, especially given the slow pace at which they are being implemented.

The authors argue that U.S. leaders must start focusing more seriously on the problem, and propose expanding U.S. funding tenfold so that it is more commensurate with the lives and inter-

ests at risk. This country now spends less than one-tenth of a percent of its \$260 billion defense budget on preventing leakage of Russian nuclear materials that can readily be made into bombs. Also, the privatization reforms encouraged by U.S. foreign policy have been a stumbling block. Privatization makes sense for consumer goods, but weapons of mass destruction call for a different approach. It is not in the interest of U.S. national security to drastically reduce government subsidies to the Russian nuclear complex, privatize it, and attempt to make it profitable while also trying to persuade the country not to market its nuclear technology and fissile materials worldwide.

Nor is such heedless privatization wise when it occurs on our own soil, and on this point *Avoiding Nuclear Anarchy* weighs in heavily, in an appendix by Richard Falkenrath that describes the near-derailment of the "highly enriched uranium (HEU) deal," one of the best ideas yet for defense conversion. Announced by President Bush in 1992 and signed by President Clinton in 1994, the HEU deal calls for the United States to buy 500 tons of weapons-grade uranium from thousands of Russia's dismantled nuclear warheads and store it safely diluted for productive use in U.S. nuclear power plants. The price—\$12 billion to be paid over 20 years of annual shipments—makes the agreement a real bargain. After all, to balance the threat of, say, 10,000 Russian nuclear weapons, the United States would have to buy and maintain some 10,000 nuclear weapons and associated missile and aircraft delivery systems of its own, at a cost of over \$100 billion.

But what started as a coordinated effort to ensure safe and economical nuclear arms reduction became a conflict of private interests within the United States and Russia, delaying implementation to 1995. The reason is that U.S. officials delegated implementation of the deal to a government group—the U.S. Enrichment Corp. (USEC)—that Congress then turned into a for-profit enterprise. And behaving just like any for-

profit enterprise would, USEC tried to lower the price to be paid to Russia for the uranium, basically reneging on the original terms of the agreement. The Russians, understandably, felt stung and refused, stalling the deal yet another year.

The sheer extent of the post-Cold War nuclear menace should make the U.S. failure to confront it adequately an election issue, whether candidates want to talk about it or not. Unfortunately, however, the matter is so frightening and complicated that the most successful politicians tend to avoid it, reinforcing widespread denial. The one presidential candidate who did speak out on the threat posed by thousands of "loose nukes," Sen. Richard Lugar (R-Ind.), did not noticeably improve his chances of winning the nomination. The top Democratic expert in the Senate, Sam Nunn of Georgia, has decided not to seek reelection.

Yet solutions are not impossible. Allison and his coauthors make a convincing case for a whole range of efforts, such as speeding the purchase of Russian HEU and plutonium, cleaning up nuclear sites, establishing an international plutonium bank to increase security, and organizing a "nuclear Interpol" to coordinate international law enforcement against nuclear smuggling and terrorism. Other ideas might include working with Russia to develop proliferation-proof, safe, and economical power reactors that would both absorb the hundreds of tons of surplus fissile material and advance peaceful economic development in energy-poor areas. We might also consider helping Russia use its nuclear complex to export electricity.

We need to talk about measures like these. The Bush and Clinton administrations and the U.S. Congress, as well as the Yeltsin administration, have made significant but still insufficient attempts to confront the new nuclear threat. The question now is whether tomorrow's leaders will come up with a better plan or obstruct even this too-modest progress. ■

CLARK C. ABT is director of the Massachusetts Defense Technology Conversion Center in Cambridge.

BOOKS



SLEEPING OFF CHERNOBYL

Chernobyl: The Forbidden Truth
by Alla Yaroshinskaya
University of Nebraska Press, \$25.00

BY MARTIN CHERNIACK

JOURNALIST Alla Yaroshinskaya began her Chernobyl-related career as a correspondent in the heavily contaminated Zhitomir region of Ukraine. Later, as a member of the Congress of People's Deputies of the USSR and appointee to a special presidential commission charged with examining management of post-Chernobyl affairs, she moved from descriptive to investigative reporting. Her book *Chernobyl: The Forbidden Truth* is a direct outcome of this work, in which she pursued administrative concealment and technical ineptitude on the part of both the Soviet government and the Communist Party. The subject matter, unfortunately, was rich.

To be sure, better books have been writ-

ten on Chernobyl, among them *The Legacy of Chernobyl* by biologist Zhores Medvedev, which is a model of scientific writing for the informed public and a classic that belongs alongside works such as Richard Rhodes's *The Making of the Atomic Bomb*. Yaroshinskaya, by contrast, is somewhat less than reliable on scientific issues. For example, she defines the possible radiation release from Chernobyl as 1 billion to 6.4 billion curies; this, in fact, is 20 to 100 times the generally accepted estimate—and though that estimate may well be too low, most authorities agree that it would be low only by a factor of 3 or 4.

Yet Yaroshinskaya's book is valuable indeed for its account of how irresponsible and poorly conceived postemergency management led to unnecessary hardships and prolonged radiation exposures. The author describes the village of Rudia-Ososhnya, only 60 kilometers from the Chernobyl power station, where soil and water irradiation prompted evacuation of cattle—to another contaminated area. The population was resettled as well, but only after a four-year delay during which they were restricted in their use of local foods and compensated only with a meager "coffin allowance" of 30 rubles per month. Yaroshinskaya goes on to write of other villages where the consumption of meat, poultry, and milk were forbidden but where monetary supplements were either discontinued or never appeared because the bureaucracy had neglected to do the necessary paperwork. While this story has been told before in the Soviet press as well as in the presses of the nations that resulted from the breakup of the Soviet Union, Western reporting has not given it similar prominence.

Moreover, Yaroshinskaya follows up on her account by posing good questions. Specifically, she asks how the Soviet-era scientific officials who managed the immediate response to Chernobyl can continue to direct Chernobyl-related investigation today. She recognizes how implausible it is that vigorous and open-minded studies on health effects will be conducted against a background of personalities and instincts honed by bureaucratic cynicism.

International Policy Failure

However, the author's emphasis on the Soviet corpse appears to exclude a thoroughgoing examination of the international scientific policy failure that has followed the Chernobyl explosion. At the 10-year anniversary of the accident this year, Western scientific organizations, in particular those based in the United States, have done astonishingly little to measure and monitor radiation health effects. The Radiation Effects Research Foundation, the Japanese and American collaborative organization that oversees research on atomic bomb survivors, is in its fourth decade and still producing important material, but no such effort seems imminent for Chernobyl.

And further studies are urgent: the Chernobyl aftermath is revealing just how limited our understanding of radiation's health effects really is. Perhaps most significantly, no one in the international scientific community was prepared for the extraordinary rise in thyroid cancer among children who were 12 or younger at the time of the explosion. Under normal circumstances such cancer is exceedingly rare at this age, with an incidence on the order of one case per million persons per year. Scientists predicted that the rate in post-Chernobyl Belarus and Ukraine would be only somewhat higher. For example, the estimate for Belarus was just nine cases, with the first ones appearing two decades after the explosion. Yet by the early 1990s Belarus had already seen more than seventy cases. The only comparable legacy of radiation-related cancer is the childhood leukemia that occurred in the wake of Hiroshima and Nagasaki.

Although scientific authorities the world over have recognized the need for long-term studies of the affected population, not a single one of the 100,000 projected participants in the Belarussian and Ukrainian thyroid cancer studies to be conducted by the U.S. National Cancer Institute has yet been enrolled. The problem is one of poor administration within and between federal agencies, and NCI must bear particular responsibility, as its administrators have had

charge of the proposed studies. There have been very few effective efforts to create centers of study in Belarus and Ukraine, enlist and compensate local professionals, or institute any kind of open advisory or peer review process, even though the necessary funds and human resources have been available.

What makes the situation all the worse is that other countries are in no position to pick up the slack. It is not that they are uninterested; indeed, respected international groups including the European Commission, the World Health Organization, and Japan's Hasekawa Foundation have competed vigorously for the opportunity to do important work on Chernobyl's health effects. But in the division of labor that has evolved at meetings of bodies such as the International Atomic Energy Agency, long-term studies of the population affected by Chernobyl have become the exclusive prerogative of the United States. This may have been reasonable, given the country's track record with the Atomic Bomb Casualty Study in postwar Japan. Then, as now, establishing long-term epidemiological surveillance was difficult because of the chaos and poverty in the region to be studied; nevertheless, a national scientific responsibility was accepted, and premier researchers rose to the occasion. Yet the United States of 1996 seems rather different from the United States of 1948–58.

Put simply, we have laid claim to what may well be the most critical area of Chernobyl research, and then sat on it. Efforts have been saturated with an empty boastfulness hardly in keeping with a society that prides itself on its pragmatism and biomedical sophistication. And our failures are not limited to the study of childhood thyroid cancer. Binational agreements have been signed with the governments of Ukraine and Belarus to conduct work on leukemia and other risks, as well as thyroid cancer, among work crews at the reactor site. Negotiations to extend research into the Bryansk region southwest of Moscow are under way, too. But current funds are probably insufficient to initiate more than one or two studies

with any likelihood of success, and not a single one is truly up and running.

Given this sad state of affairs, what the United States needs is to produce some investigative reporting of its own. With any luck *Chernobyl: The Forbidden Truth* will serve as an inspiration—or, better, a goad. The time is more than ripe for an American counterpart to Alla Yaroshinskaya who will point out that the nation must accept a disproportionate share of the blame for an uncooperative and woefully insufficient international research effort on the health effects of Chernobyl. ■

MARTIN CHERNIACK is the former field director of the National Cancer Institute's pediatric thyroid cancer study in Belarus. He is currently medical director of the Ergonomics Technology Center at the University of Connecticut Health Center in Farmington.

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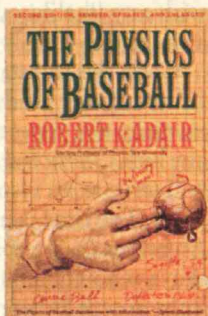
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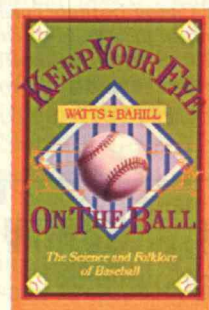
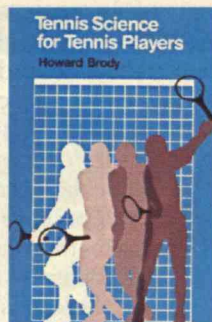
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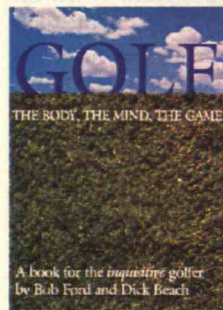


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LETTERS

CONTINUED FROM PAGE 64

die even though tools to drastically reduce the losses are now in hand?

The path to successful volcano-hazards mitigation is clear, at least in the abstract. First, scientists must study a volcano's past behavior to determine which areas are at risk from future eruptions. Next, public officials must use the resulting maps to formulate responsible land-use plans. An encouraging step in this direction is the Washington Growth Management Act of 1990, which mandates the identification of hazards near rapidly growing counties. The wisdom of state legislators may not be fully appreciated for generations—until Mount Rainier sends more debris down a valley where schools, hospitals, and high-density housing could have been located. A third step involves using the monitoring techniques described by Tyson plus new ones that are likely to be developed. Fourth, scientists and public officials must work together to formulate realistic response plans. Throughout the entire process, citizens must be kept informed of both the risks and the means available to mitigate them.

As noted by Tyson, the 1994 volcanic eruptions near Rabaul, Papua New Guinea, provide compelling evidence of the efficacy of public education and emergency response planning. Unfortunately, residents of the western United States, where hazards information is sometimes unwelcome due to its potential impact on property rights, have still not heeded this important lesson.

Can society coexist with dangerous volcanoes? The answer is yes. Volcanic hazards derive from impersonal acts of nature, but volcanic risk is the result of decisions, informed or otherwise, made by individuals and society. Decisions made by today's citizens and leaders are sure to affect future generations, for better or worse. We have the technical means to avert future volcanic disasters. Whether we have the wisdom and will to do so remains an open question.

DANIEL DZURISIN

U.S. Geological Survey
Cascades Volcano Observatory
Vancouver, Wash.

Given unlimited resources, we could predict any volcanic eruption. Ideally, we would monitor seismicity, ground deformation, gravity, and magnetic fields—everything—and detect changes that might be the precursors to activity. Such measurements would enable us to develop a detailed model of individual volcanoes and learn more about eruption-trigger mechanisms. But funding is primarily restricted to volcanic crises, thereby prohibiting scientists from acquiring baseline data.

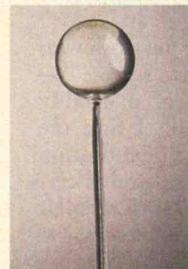
HAZEL RYMER
Department of Earth Sciences
The Open University
Milton Keynes, England

"Under the Volcano" was fascinating. However I was unaware that Mount St. Helens had moved from the state of Washington to the state of Oregon. Maybe the tectonic plates are shifting faster than I thought!

BRUCE E. LANDRY
Seattle, Wash.

ANOTHER BRIGHT IDEA

I was amazed that Seth Shulman covered only half the story in his otherwise interesting piece "Brighter, Whiter Lights" (*Trends*, TR January 1996). A golf ball-sized bulb that generates 450,000 lumens



is indeed remarkable but totally unusable without a second component. The simple words "prismatic reflecting film" in the diagram of the light pipe (page 15) are the key to the rest of the story, because the

film enables light to be delivered in a pleasing, uniform, low-glare manner. The National Air and Space Museum used three light pipes lined with reflecting film, each powered by two sources of small sulfur lamps, to uniformly light its space. The synergy between the two inventions made the NASM system workable, and can prove effective in many other applications as well.

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Phenomena*

By DAVID BRITTAN

ANAGRAMS MADE EASY

ONE of the few traits I will admit to sharing with Hannibal Lecter, the gruesome antihero of the movie *Silence of the Lambs*, is a fondness for fava beans. Really, they're not as bad as they look, particularly if savored with a nice chianti. We have another passion in common, though, and I'm almost ashamed to mention it: a love of anagrams. Call it a mental tic—a camel tint, an intact elm. For some perverse reason, the urge to rearrange the letters on billboards, license plates, or bathroom products (especially those) proves overwhelming. Introduced at a party to someone named Marianne, I might slip and say, "Nice to meet you, Armenian."

This is no great sign of intelligence (and no great source of dates either). My Scrabble score is unremarkable, and the simple transpositions I tend to indulge in—tide, tied, edit, diet—are of a kind that single-celled organisms probably do in their sleep. Truly devious anagrammatists scramble words in ways the rest of us can only marvel at: heavy rain?/hire a navy; dormitory/dirty room; astronomers/no more stars/moon starers; desperation/a rope ends it; Presbyterian/best in prayer. One can imagine the monastic oil burning to transform "Ave Maria, gratia plena, Dominus tecum" ("Hail Mary, full of grace, the Lord is with thee") into "Virgo serena, pia, munda, et immaculata" ("Virgin serene, holy,

pure, and immaculate"). So it is with a mixture of sadness and glee that compulsive scramblers watch the baton of anagrammatic skill pass from monks and convicts—those with a lot of time on their hands—to computers.

Anagram generators, a form of software now widely available, take the brainwork out of recombinant wordplay. What wordsmiths used to achieve through patience and wit, software can do through brute force. When I asked Ars Magna, a popular Macintosh shareware program available on the World Wide Web, for anagrams of "Technology Review," it obliged

with thousands of possibilities, generating a file that swelled to 476K before my Power Mac had a grand-mal seizure. Likewise, a multilingual anagram generator on the Web gave me hundreds of new combinations of the word "anagramming." But many were so obscure that I had to make sure the program was set for English. "Grim maga nan," "minar mang ga"—would that be Gaelic? Anglo-Saxon? The cries of the proverbial thousand monkeys?

With so many choices, the burden of finding a suitable anagram still rests on humans. To narrow the results, a commercial program called Anagram Genius (Windows) lets you specify, among other things, whether your subject is male, female, or inanimate;

whether you aim to flatter or to satirize; and whether you wish to see "vulgar" words (why even ask?). But ultimately only we know if an anagram has that zing.

Therein lies the thrill of discovery, which anagram generators provide in a Cuban den—er, in abundance. One can only envy the user of Anagram Genius who (according to the developer's Web site) entered the phrase "the meaning of life" and uncovered "the fine game of nil." Or the person who typed "President Boris Yeltsin" and turned up "endless insobriety trip," or who transformed "Scottish National Party" into "oh nasty tartan politics."

My exhaustive search for anagrams on "Technology Review" yielded nothing quite so apt—I don't think we would want to use "the clever yogi won" in our

hotly vow in Greece to howl icy revenge. They grieve, cowl on over Ceylon wig, the once weighty lover.

We've no gothic lyre.
We've no glory ethic.
We've no holy rig, etc.—
no wet gyro vehicle
or cogent ivy wheel.
Yet her novice glow
wove gently heroic.

Cheery evil won't go.
Ivy gel won't cohere.
They grow violence
with yon clever ego,
never with ecology.

Why, o genetic lover,
or why genetic love—
oh wry genetic love—
glory once with Eve?
Or convey with glee
their coy Gwen? Love
the low grey novice.

Review thy cologne,
Greenwich love-toy.

Haunting, isn't it? Note that without any prompting, the Ars Magna software allowed me (and I must emphasize that I was merely the conduit) to use words like "o" and "thy," and even to lace the work with classical allusions ("Greece")—the hallmarks of a quality poem. All in all, I find the result of this collaboration deeply satisfying, and it certainly makes as much sense as any poem I've read in the *New Yorker* lately.

The strange compulsion to scramble letters is probably a lifelong habit, like eating fava beans. My hope is that by bringing the pleasures of anagramming to millions more people, today's software will lessen the stigma attached to it, allowing the obsessive anagrammatist to come out of the closet and be free as a flutterby. Or was it a butterfly? ■

promotion-
al material. But the search did provide the basis for a new form of human-machine collaboration that could be termed CAD (computer-aided doggerel). It is quite likely that no other magazine in history has inspired a lyric poem in which every line is an anagram of the publication's title. I call this little creation "Cooler Even Thy Wig":

O the cowering levy,
o the glycerine vow.
I clothe every gown
with coy green love.

They love cowering
who in covert elegy



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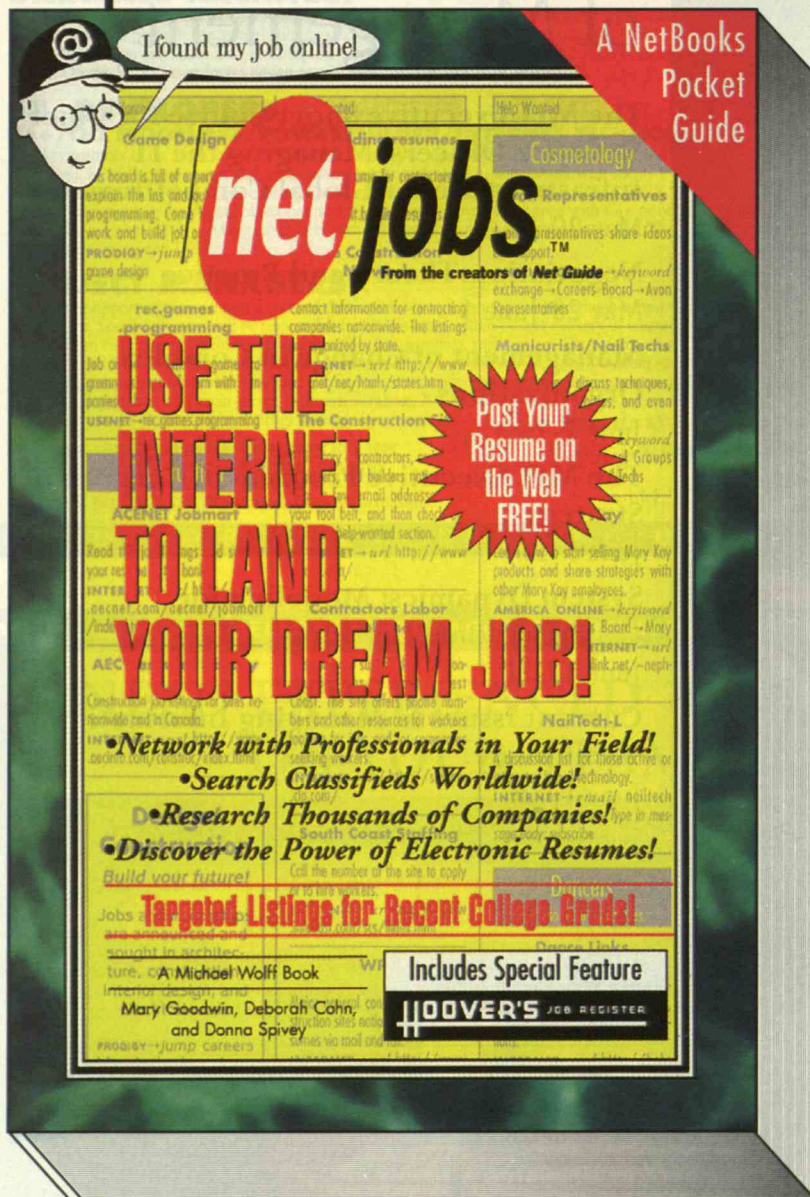
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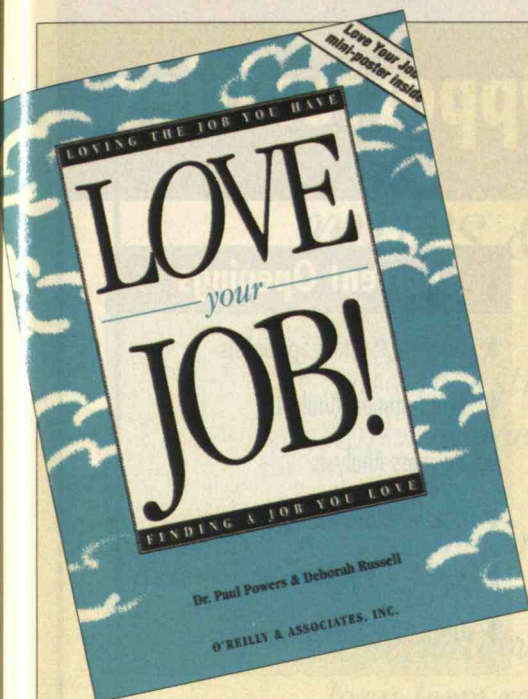
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